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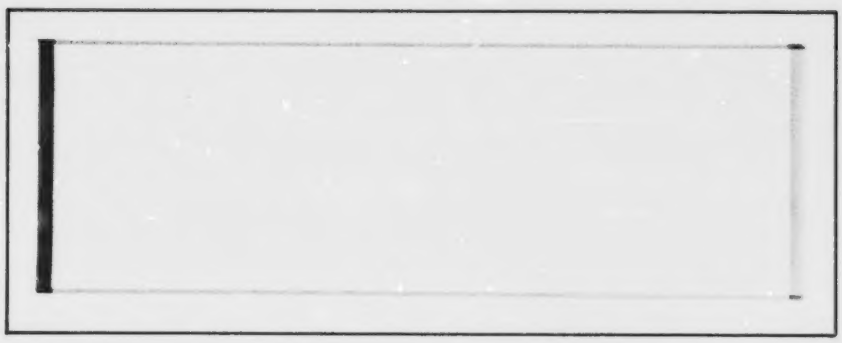

WORKING PAPER

Marketing and Economics Branch

Direction générale de la commercialisation et de l'économie

Working papers are (1) interim reports completed by the staff of the Marketing & Economics Branch, and (2) research reports completed under contract. The former reports have received limited review, and are circulated for discussion and comment. Views expressed in these papers are those of the author(s) and do not necessarily represent those of Agriculture Canada.

THE ECONOMIC POTENTIAL FOR CONCENTRATED APPLE JUICE PRODUCTION IN CANADA

(Working Paper 10/85)

Marketing and Economics Branch
Agriculture Canada

May 1985

THE ECONOMIC POTENTIAL FOR CONCENTRATED APPLE JUICE PRODUCTION IN CANADA

A REPORT FOR

MARKETING AND ECONOMICS BRANCH

AGRICULTURE CANADA

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EXECUTIVE SUMMARY

Canada has historically marketed about forty percent of its apple production as processed products (juice, sauce, slices,and pie filling). Over the last ten years reconstituted apple juices made from imported concentrates have captured an increasing share of the Canadian apple juice market. This development has a number of implications both within the processing sector and in the apple industry as a whole.

Recognizing that Canada has an increasing apple production base and that reconstituted apple juice is a growing market for processed apples, Agriculture Canada commissioned this study of the economics of apple juice concentrating. This report includes an examination of world trade in apple juice concentrates, the apple production and processing sectors in major concentrate exporting countries, the characteristics of the Canadian production and processing sectors, the technical aspects of concentrating facilities (with estimates of capital and operating costs), opportunities to increase processing apple production through adoption of specialized production techniques, and the consumer market for apple juices in Canada.

CANADIAN PRODUCTION AND PROCESSING

Apple production in Canada reached a record of over 550 kilotonnes in 1980 but has been between 400 and 500 kilotonnes in subsequent years. Over the last ten years Canada has been a net importer of apple products (if both fresh apples and the fresh equivalent of processed apple products are considered). Fresh apples and concentrated apple juice are the major import commodities while fresh apples and "pure" juice are the major exports. The fresh apple equivalent of net concentrate imports was approximately 130 kilotonnes in 1983. This represents a quantity of apples approaching 25 % of Canadian apple production. Between fifty and sixty percent of the crop is normally marketed for fresh consumption but there are substantial differences between regions. Using average data for the years 1979 to 1983 as the basis for comparison, fresh marketings in New Brunswick exceed 80% of production, 70% in British Columbia, and are as low as 40% in Nova Scotia. The processing sector is an important market outlet for apple production, especially in Ontario and Nova Scotia.

Within the processing sector juice is by far the most important product. Juicing accounts for from 65% of processing apple utilization in Nova Scotia to almost 90 % in British Columbia. The activities of the processing sector

in each region are related to a number of characteristics of the industry. Particularly important are the size of the market for fresh apples in relation to production, the availability of storage facilities, and the varieties of apples available for processing.

The Delicious variety accounts for over 50% of production in British Columbia, about 20% in Ontario, and 10% in Nova Scotia. The McIntosh variety accounts for over 70% of Quebec production, over 50% of New Brunswick production, and over 20% of production in Ontario, Nova Scotia, and British Columbia. Spy is an important variety in Ontario and Nova Scotia only, Cortland in Quebec and the Maritimes only. Spartan is an important variety in British Columbia and is increasing in importance in Ontario.

Red Delicious, Spartan and Cortland are best suited for the fresh market. McIntosh and Northern Spy are good dual purpose apples. Both produce a flavourful juice. Spy stores exceptionally well and maintains shape when cooked.

A concentrating facility of sufficient size to allow reasonably efficient operation requires a substantial supply of apples. The plant described in Chapter III would consume about fifteen thousand tonnes of apples per season. This represents approximately all of the apples currently juiced in Nova Scotia, half of those currently juiced in Quebec, one quarter of those currently juiced in Ontario, or one third of those currently juiced in British Columbia.

Although the varieties available in Nova Scotia would produce a high quality concentrate it would seem inappropriate to devote a very large proportion of processing apple availability to concentrating when an adequate market for "pure" juice exists. The marketing approach taken in B.C. and the varieties available for processing both detract from the desirability of a concentrating facility in that province. Ontario and Quebec have suitable varieties and sufficient production to support concentrating but such a facility needs justification other than an adequate supply of apples when a market for "pure" juice exists.

The basic problem to be dealt with is how best to compete with imported concentrate. Even if Canadian apple production rises dramatically import substitution will be the most appropriate method of marketing the additional production. The major advantages of imported concentrate are low cost, availability throughout the year (enabling canners to more fully utilize their equipment), and ability to maintain consistency in the product.

The major disadvantage is that the product is reconstituted, must be identified as such, and is less acceptable to the consumer than "pure" juice.

WORLD APPLE PRODUCTION AND TRADE

The countries of major interest in the current context are those supplying significant quantities of concentrated apple juice to the Canadian market. On the basis of shares of total concentrate imports from 1976 to 1983 the most important suppliers were Argentina (21% of imports), South Africa (19%), the United States (12%), Austria (8%), Chile (7%), Hungary (7%), and West Germany (6%). Information on production, imports and exports of fresh apples, and processing utilization for these countries is presented in the report.

The major exporters of concentrates can be divided into two broad categories. South Africa, Argentina, and Chile are countries which are substantial net exporters of fresh apples. The production practices in these countries emphasize the production of high quality apples for export and concentrated juice is used as a method of disposing of cull apples that cannot be absorbed in the domestic market.

The other category consists of countries such as the U.S., West Germany, and Austria which are net importers of apples and/or apple products but which show substantial exports of concentrate to Canada. In the case of Austria concentrate exports are largely trans-shipments from Eastern Europe. The same situation is prevalent to a lesser extent in West Germany but that country is also a major apple producer. Trans-shipments from South America are thought to account for a large part of imports from the United States.

COSTS OF MANUFACTURING APPLE JUICE CONCENTRATE

Chapter III describes the processing and equipment requirements and gives estimated costs for manufacturing high-density (71 Brix) concentrated apple juice. The plant envisioned here starts with raw apples, converts them to single strength juice, and then to apple juice concentrate. The hourly capacity of the plant is 750 kg of 71 Brix concentrate. This requires a single strength juicing capacity of 4620 kg per hour assuming that the juice produced averages 11.5 Brix. At 70% yield of juice 6.6 tonnes of apples per hour would be required to supply the plant.

The capital cost of such a plant is estimated at $1,454,300, annual fixed costs at $610,102, and variable costs of concentrate produced at $1.137/kg.

Apple juice concentrate prices on the international market have fluctuated between 1000 and 1500 dollars U.S. per metric ton over the last few years. If a price of $1270 is chosen (U.S.$6.50/U.S. gallon) then the price of imported concentrate in Canadian currency will be about $1670 per metric ton. A breakeven analysis based on this price and the fixed and variable costs of operating the plant described above shows that at an annual production of 500 metric tons which is roughly equivalent to two months of operation at 14 hours per day, the cost of producing concentrate is $2360 per metric ton. If the plant were operated on the same basis over a period of seven months, the per tonne cost of concentrate produced would drop to $1545. The breakeven point occurs at a production of approximately 1,200 metric tons (four months of operation).

ALTERNATIVE PRODUCTION PRACTICES IN ORCHARDS

Throughout all apple producing regions of Canada the overriding production practice has been the maximization of apple production for the fresh market. Apples used for processing have generally been treated as a by-product of fresh market production. As the production of fresh market apples in Canada may exceed requirements in the near future there may be a need to consider processing apples as an important product contributing to the viability of apple producing enterprises.

Chapter IV examines the market factors and production practices that determine the attractiveness of producing apples for processing; and some of the problems, constraints, and opportunities in apple production. Cost of production studies for normal production practices were developed and then the impact of changes in production practices designed to increase output of processing apples was examined by changing the appropriate parameters in the cost of production models.

Using returns to management as the indicator of desirability, Ontario and Nova Scotia producers would be marginally better off specializing in processing apple production. Conversely, producers in British Columbia and Quebec would be better off maintaining their present practices. It must be realized that these results only hold true if there is no detrimental effect on processing apple prices due to an increase in production. On an individual farm basis price effects could be ignored, but in aggregate supply increases must be considered.

The major underlying reason for the feasibility of juicing systems in Ontario and Nova Scotia is the relatively low proportion of the crop that goes to the fresh market. With only 40% of production being directed through the fresh market, reducing the fresh/processing split from 40%/60% to 25%/75% while increasing the yield only results in a relatively small reduction in the amount of apples supplied to the fresh market. Conversely, producers with a high proportion of fresh sales are better to continue the production practices that allow them to harvest a high proportion of fresh apples.

If a program to promote specialization in production of apples for processing is instituted not only must the returns be equal to the present system, but those returns must remain equal in the long run. Should juice apple prices decline because of increased production, returns to those specializing in processing apple production will decline at a much greater rate than to those producing under the present system since the fresh market may not be seriously affected. The second consideration is the world price for apple juice concentrates. Concentrate prices in the international market have been under pressure over the last five years and the prospects for a reversal of the situation are not encouraging. A producer locked into a specialized system may well face downward pressure on domestic juice markets due to declining world market prices for concentrate.

The analysis suggests that an opportunity exists to increase specialized processing apple production in Ontario, Nova Scotia, and possibly in Quebec. However, overcoming the risk of future price fluctuations must be given consideration before specialized processing apple production techniques are recommended on a wide scale.

DEMAND SITUATION AND OUTLOOK

Imports of concentrated apple juice have increased from 2.3 kilotonnes in 1976 to 15.1 kilotonnes in 1984. Concentrated apple juice is a commodity with a number of characteristics that facilitate international trade. It has a relatively high value to weight ratio, requires no special shipping or storage facilities (i.e. refrigeration is not necessary), and it keeps well without the addition of preservatives.

For the three years 1970 to 1972 disappearance of pure apple juice averaged 2.5 kg per capita while disappearance of reconstituted apple juice averaged 0.28 kg per capita. During that period reconstituted juice represented

approximately 10% of all apple juice disappearance. For the three years 1980 to 1982 disappearance of pure apple juice averaged 4.36 kg per capita while disappearance of reconstituted apple juice averaged 1.69 kg per capita. Reconstituted juice's share of total apple juice consumption had risen to about 28%. During the ten years between these two periods substantial increases in the consumption of both pure and reconstituted apple juices took place. Pure juice consumption almost doubled while reconstituted juice consumption increased sixfold.

Previous studies implying that milk, orange juice, and apple juice are substitutes leads to a logical grouping of these beverages as cold "health" beverages consumed mainly at home. Orange juice has the additional characteristic (handicap perhaps) of being considered a "breakfast" drink. Such a grouping separates these from other major beverage groupings such as the "hot" beverages (tea and coffee) and the alcoholic beverages (wine, beer, and spirits). Soft drinks, differ from milk, orange juice and apple juice in the "health" aspect and in the greater tendency for soft drinks to be consumed away from the home. Apple juice has advantages as an all-day substitute for milk in the home and as a health alternative to soft drinks away from home.

Per capita consumption of some of the beverages shows a strong upward trend. These include orange juice, apple juice, and wine. Others show weaker trends (milk, tomato juice, and soft drinks) or even declining consumption (beer). Reasons for the strong performance of wine, orange juice, and apple juice in relation to the other beverages remain a matter of conjecture. The two most often put forward are increasing per capita incomes and changes in consumer tastes and preferences. The case for changing tastes influencing orange and apple juice consumption is most often related to an apparent increase in health consciousness.

The projections presented imply that from the 1981-83 base period consumption of pure juice will almost double by the year 2000 while consumption of reconstituted juice would more than double. The share of reconstituted juice would increase from 28 to 35 percent of total apple juice consumption.

Total disappearance of pure juice would increase by approximately 100 kilotonnes. At 70% juice yield this would represent about 143 kilotonnes of apples. At a yield of 20 tonnes per hectare this would in turn represent production from an additional five thousand hectares.

The long term outlook then, provides opportunity for expansion of domestic production but with some erosion of pure juice's share of the total apple juice market. The rapid increase in market share experienced by reconstituted juice in 1982, 1983 and 1984, although alarming to a degree, is probably a temporary situation due to lower than usual domestic production. As the effects of the 1981 frost damage are overcome pure juice should be able to recover its position in the market.

FOUR BASIC STRATEGIES

Four basic strategies for supplying the market for apple juice are examined.

The first strategy would involve storing raw apples at harvest and operating a juicing and packaging facility throughout the storage season. This could involve either the grading of apples at harvest and storage of fresh market and juicing apples separately, or the storage of orchard run apples to be graded as they come out of storage. This strategy cannot be applied to mechanically harvested apples however, because storage losses would be prohibative.

The second strategy would involve juicing apples during the harvest period and storing the single strength juice in bulk for packaging throughout the year.

The third strategy would involve the manufacture of concentrated juice at harvest, storage of the concentrate, and reconstitution and packaging over an extended period.

The fourth strategy would involve juicing and packaging the product during the harvest season and storage of the juice in retail packages.

The analysis points out several key variables that must be considered carefully. First, the relative cost of storing raw apples, concentrate, bulk juice, and retail packaged juice is a crucial element. Second, the cost implications of operating juicing and concentrating facilities only during harvest rather than throughout the year must be clearly understood. Indeed, for canners one of the greatest attractions of imported concentrate is the fact that the raw material for their canning operations is available and they can operate throughout the year reducing their unit overhead costs. Finally, carrying charges vary significantly between the strategies because the value of inventory to be carried varies considerably in the different strategies.

Since Canada is a net importer of apples and apple products and is likely to remain so for the foreseeable future it seems inappropriate to try to compete on the international concentrate market. Concentrating facilities in Canada would therefore be expected to operate only during harvest to produce a product that would compete with imported concentrates. This would in turn remove "pure" juice (which is preferred by consumers and commands a price premium) from the Canadian market.

The two crucial elements of an appropriate strategy are that the emphasis on pure juice be maintained since the market apparently still prefers the pure product, and that some effort be made to provide packers with a supply of pure juice for packaging throughout the year in order to reduce the attractiveness of reconstituting. The strategies that best meet these requirements appear to be bulk storage of single-strength juice, and storage of apples for juicing throughout the storage season.

The main difficulty to be overcome if the storage of raw apples strategy is adopted is ensuring that the juice packer will be able to produce a juice of consistent quality. This would involve additional planning with regard to the varieties grown and stored for juicing purposes.

Another option would be to facilitate the marketing of blended pure and reconstituted product. This approach would allow packers to maintain consistent quality but consumer attitutes to blended products are crucial in this approach, and are not at present known.

The option that appears to meet both criteria at a reasonable carrying charge and without the product being subject to a price discount is the bulk storage of juice. Unfortunately, experience with this new concept came to light as this report was being completed and a detailed evaluation of costs and other advantages or disadvantages of bulk storage was not possible. Bulk storage of single strength juice would allow packers to package a "pure" product of consistent quality throughout the year.

I CANADIAN PRODUCTION AND PROCESSING

Apple production in Canada reached a record of over 550 kilotonnes in 1980 but has been between 400 and 500 kilotonnes in subsequent years largely due to adverse weather conditions in the winter of 1980-81 which caused extensive damage to orchards in Quebec, and to a lesser extent in Ontario and Nova Scotia. Five Canadian provinces have major apple producing areas. Using five year averages of production (1980 to 1984) as a basis for comparison British Columbia accounts for approximately 40% of Canadian production, Ontario for about 30%, Quebec for about 15%, New Brunswick for about 1% and Nova Scotia for about 10%. A summary of production by regions is presented in Table I.1.

Over the last ten years Canada has been a net importer of apple products (if both fresh apples and the fresh equivalent of processed apple products are considered). Fresh apples and concentrated apple juice are the major import commodities while fresh apples and "pure" juice are the major exports. Imports and exports of fresh apples are shown in Figure I.1. From 1970 to 1973 Canada was a net exporter of fresh apples but has been a net importer since. Imports and exports of concentrated apple juice are shown in Figure I.2. Imports have exceeded exports by a considerable margin throughout the 1970 to 1983 period. The fresh apple equivalent of net concentrate imports was approximately 130 kilotonnes in 1983. This represents a quantity of apples approaching 25% of Canadian apple production. The exports of concentrate shown in Figure I.2 consist of re-exports as well as domestically produced concentrates. Concentration of apple juice is carried on by at most three or four Canadian companies, all of which are relatively small scale operations. In spite of this, export marketings of domestically produced concentrates have been significant.

Canadian apple marketings for fresh consumption and for processing are presented in Table I.2 and in Figure I.3. Between fifty and sixty percent of the crop is normally marketed for fresh consumption but there are substantial differences between regions. Using average data for the years 1979 to 1983 as the basis for comparison, fresh marketings in New Brunswick exceed 80 % of production, 70 % in British Columbia, and are as low as 40 % in Nova Scotia. The processing sector is an important market outlet for apple production, especially in Ontario and Nova Scotia.

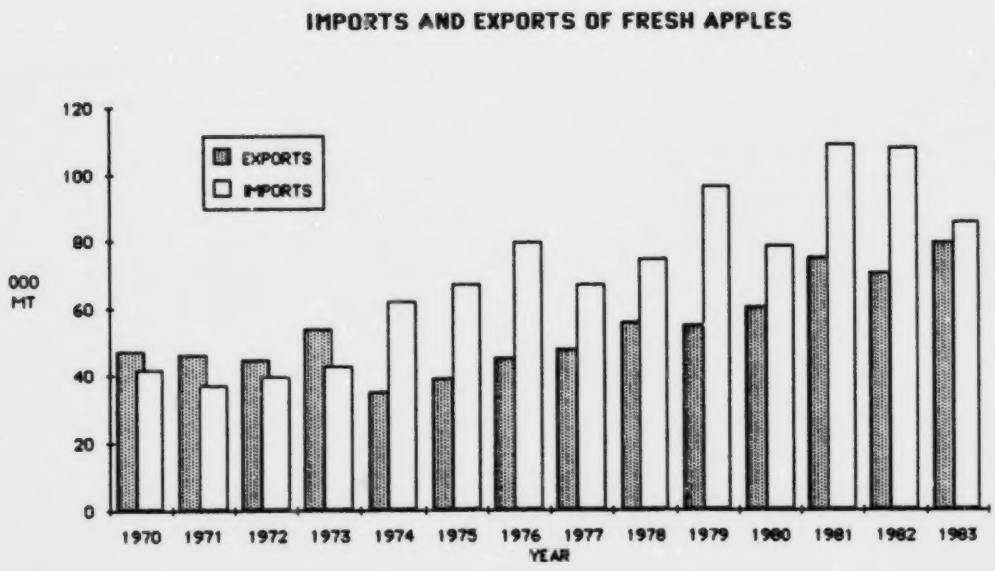
Within the processing sector juice is by far the most important product. Data presented in Table I.3 and Figure I.4 show that juicing accounts for from 65% of processing apple utilization in Nova Scotia to almost 90 % in

TABLE I.1:- Apple Production in Canada by Province (Metric Tons)

CROP YEAR	BRITISH COLUMBIA	%	ONTARIO	%	QUEBEC	%	NEW BRUNSWICK	%	NOVA SCOTIA	%	CANADA
1970	132.099	32.6	128.670	31.7	85.119	21.0	6.287	1.6	53.342	13.2	405.517
1971	86.281	22.1	128.803	32.9	119.201	30.5	8.287	2.1	48.580	12.4	391.153
1972	110.171	28.0	125.260	31.9	114.039	29.0	6.192	1.6	37.149	9.5	392.810
1973	145.587	38.9	92.054	24.6	89.425	23.9	5.715	1.5	41.912	11.2	374.693
1974	108.990	26.8	124.478	30.6	125.221	30.8	4.763	1.2	42.864	10.5	406.317
1975	166.219	36.1	130.194	28.3	108.590	23.6	5.906	1.3	49.532	10.8	460.441
1976	172.715	42.2	116.001	28.3	72.260	17.7	5.334	1.3	42.864	10.5	409.175
1977	142.710	34.7	127.850	31.1	94.188	22.9	4.763	1.2	41.912	10.2	411.423
1978	150.426	33.3	142.672	31.6	101.675	22.5	5.715	1.3	51.437	11.4	451.925
1979	151.245	34.8	140.424	32.3	91.216	21.0	5.906	1.4	46.103	10.6	434.894
1980	210.246	38.0	171.344	31.0	118.516	21.4	5.334	1.0	47.151	8.5	552.590
1981	197.060	47.2	115.574	27.7	45.303	10.9	4.953	1.2	54.486	13.1	417.375
1982	175.423	36.7	159.035	33.3	78.109	16.4	6.001	1.3	59.058	12.4	477.626
1983	194.954	40.2	165.192	34.1	65.078	13.4	6.287	1.3	53.342	11.0	484.853
1984	149.240	33.9	143.846	32.7	85.081	19.3	4.286	1.0	58.105	13.2	440.559
AVE 80-84	185.385	39.1	150.998	31.8	78.417	16.5	5.372	1.1	54.428	11.5	474.600

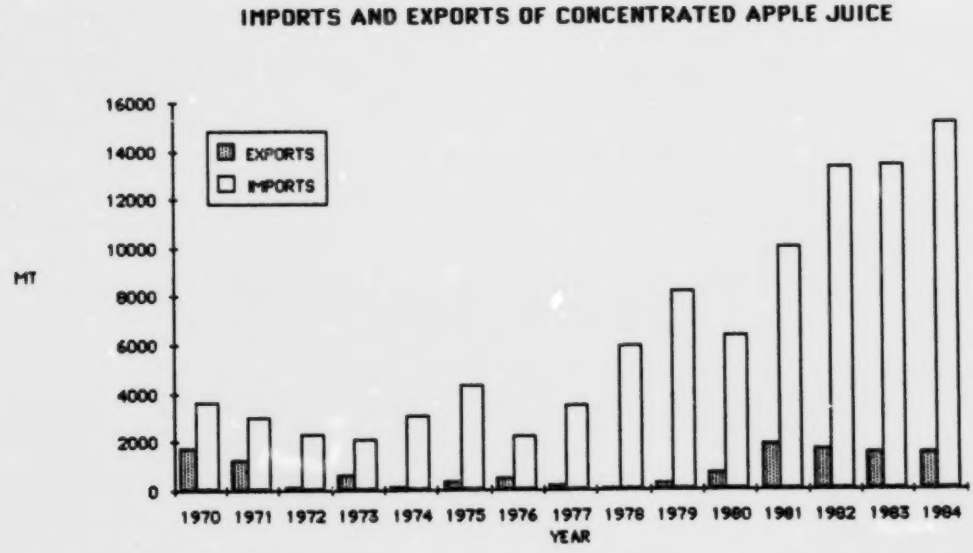
SOURCE: Statistics Canada Catalogue 22-003 Fruit and Vegetable Production.

FIGURE 1.1:-



SOURCE: Statistics Canada Catalogue 32-230, Apparent Per Capita Food Consumption in Canada

FIGURE 1.2:-



SOURCE: Statistics Canada, Trade of Canada (1970 to 1975 Imports estimated)

Table I.2:- Apples, Fresh Market Sales and Sales to Processors (Metric tons)

CROP YEAR	BRITISH COLUMBIA		ONTARIO		QUEBEC		NEW BRUNSWICK		NOVA SCOTIA	
	FRESH	PROCESSED	FRESH	PROCESSED	FRESH	PROCESSED	FRESH	PROCESSED	FRESH	PROCESSED
1975	120946	45267	59148	71032	73632	34958	5906		19165	30367
1976	138845	33878	67096	48897	42483	29777	5334		19146	23718
1977	103457	39248	61225	66630	51799	42389	4763		17489	24423
1978	111878	38557	73671	69006	61004	40670	5715		20308	31129
1979	110143	41097	64977	75456	54730	36486	5906		20613	25490
1980	155818	54433	86796	84539	82700	35816	5335		18442	28710
1981	132850	69212	44222	71353	27182	18121	4953		20118	34368
1982	138693	36730	81498	77537	54676	23433	4191	1810	21337	37721
1983	129466	65488	65153	100039	45555	19523	4401	1886	24328	29014
AVE 79-83	133394	53392	68529	81785	52969	26676	4957	739	20968	31061
% OF PROV. TOTAL	71.4%	28.6%	45.6%	54.4%	66.5%	33.5%	87.0%	13.0%	40.3%	59.7%

SOURCE: Statistics Canada Catalogue 22-003, Fruit and Vegetable Production.

FIGURE I.3:-

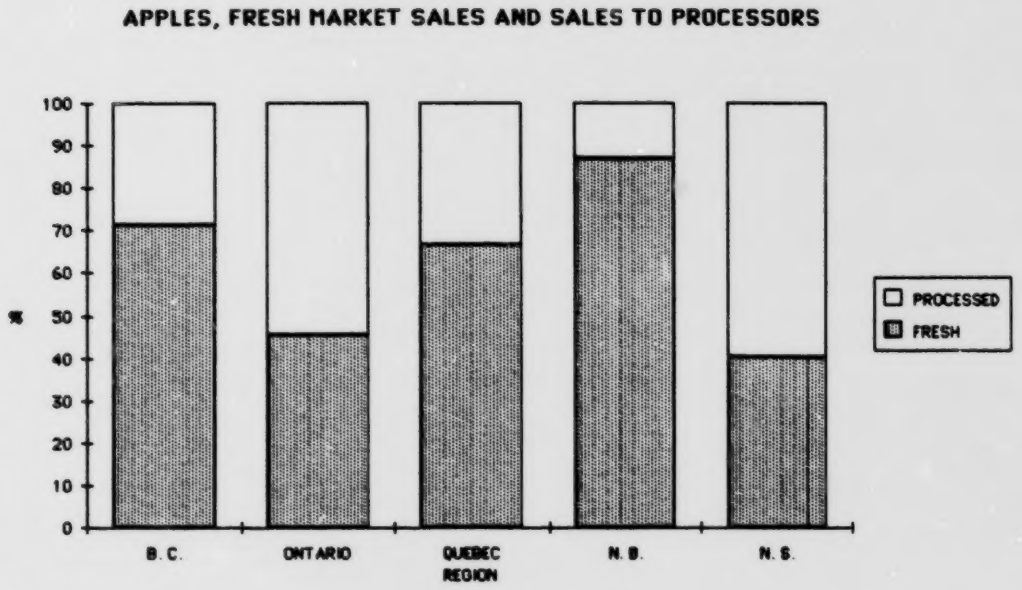


FIGURE I.4:-

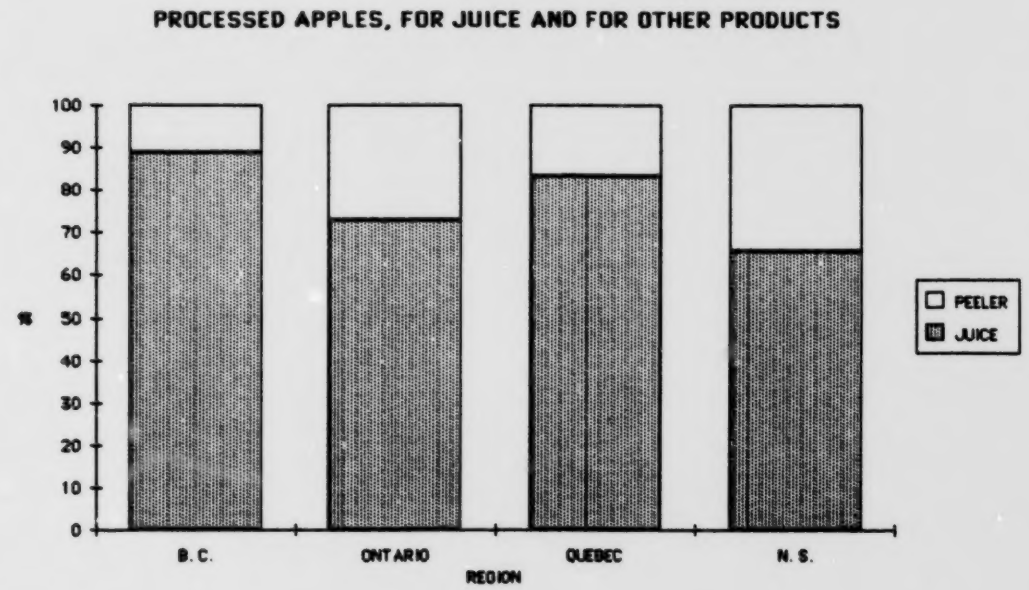


TABLE I.3:- Processing Apples, Used for Juice and for Other Products (Metric Tons)

CROP YEAR	BRITISH COLUMBIA		ONTARIO		QUEBEC		NOVA SCOTIA	
	PEELER	JUICE	PEELER	JUICE	PEELER	JUICE	PEELER	JUICE
1973	9740	30141	19549	26061	9955	17657	11747	8724
1974	5070	18012	19849	51376	15914	27038	11291	16396
1975	5601	44070	17814	51929	10242	24713	11498	18868
1976	2823	47536	18773	58173	9926	19846	8469	15252
1977	6286	28440	21013	78891	8679	37046	7614	16808
1978	6940	34649	21319	61235	12772	37097	10408	20729
1979	4250	36234	21639	56998	7533	37974	11281	14216
1980	6623	57925	28218	64836	4643	46601	8898	19809
1981	3167	65413	27104	57453	2422	20304	11177	22892
AVE 75-81	5453	44532	23859	63883	7210	35804	9876	18891
% OF PROV. TOTAL	10.9%	89.1%	27.2%	72.8%	16.8%	83.2%	34.3%	65.7%

SOURCE: Agriculture Canada, A Study of Canada's Apple Industry, Tables 103, 109, 113, 117

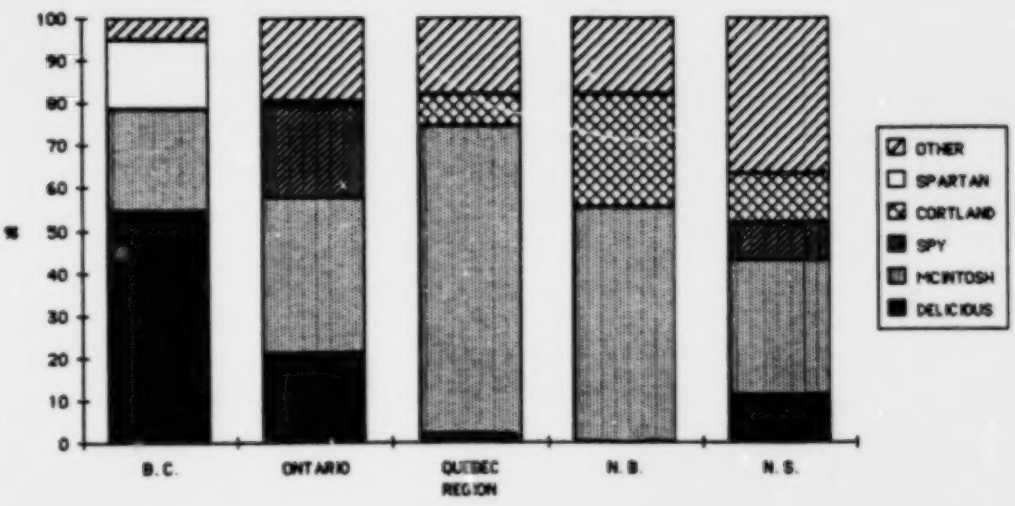
British Columbia. Other processed products include canned apples, frozen apples, apple sauce, and apple pie filling. Processing of products other than juice is most important in Ontario and Nova Scotia.

The activities of the processing sector in each region are related to a number of other characteristics of the industry. Particularly important are the varieties of apples available for processing, the size of the market for fresh apples in relation to production, and the availability of storage facilities.

Apple production by variety and by region is presented in Table I.4 and Figure I.5. The Delicious varity accounts for over 50 % of production in British Columbia, about 20 % in Ontario, and 10 % in Nova Scotia. The McIntosh variety accounts for over 70 % of Quebec production, over 50 % of New Brunswick production, and over 20 % of production in Ontario, Nova Scotia, and British Columbia. Spy is an important variety in Ontario and Nova Scotia only, Cortland in Quebec and the Maritimes only, and Spartan in British Columbia only.

FIGURE I.5:-

APPLES, VARIETAL COMPOSITION OF PRODUCTION



Red Delicious, Spartan and Cortland are best suited for the fresh market. Red Delicious keeps well and is a preferred fresh eating apple. It has a

number of undesirable characteristics when used for processing including flat taste, coarse texture, and low acid content. Spartan has many of the same advantages in the fresh market and disadvantages in the processing market. Cortland, although primarily a fresh market apple, has medium acidity and discolours slowly when sliced making it more suitable for processing than Delicious or Spartan. McIntosh and Northern Spy are good dual purpose apples. Both produce a flavourful juice. Spy stores exceptionally well and maintains shape when cooked.

The predominance of Delicious and Spartan in British Columbia leaves a relatively small production base of varieties suitable for processing. This, and the additional contribution of McIntosh to total production, corresponds with the high proportion of juicing in processing activity. The availability of Northern Spy in Ontario and Nova Scotia corresponds to the higher proportion of peeling in processing activity.

In Eastern Canada processing activity is concentrated in the harvest period while in British Columbia processing activity occurs throughout the storage season. There are a number of reasons for this and a number of consequences. The general approach in B. C. is to put a high proportion of production (almost all of which consists of fresh market varieties) into storage and to grade product as it comes out of storage. The result is a steady supply of cull apples as the storage season progresses, relatively high stocks at December 1 (see Table I.5 and Figure I.6), and the predominance of juice in the processed product mix (Figure I.4). In Eastern Canada the more common practice is to cull apples before storage creating an abundance of processing apples at harvest and reducing the proportion of the crop in store on December 1. In fact, the net storage of apples is probably not much different between B.C. and Eastern Canada, it is just a matter of apples being stored in processed rather than fresh form in Eastern Canada.

TABLE I.4:- Apple Production by Varieties and by Region (Metric Tons)

	DELICIOUS	MCINTOSH	SPY	CORTLAND	SPARTAN	OTHER	TOTAL
B. C.							
1979	82873	34092			24295	9984	151243
1980	113546	53487			29341	13881	210254
1981	110642	45051			33603	7770	197066
1982	94733	43656			28963	8074	175426
1983	104763	47713			33663	8817	194957
79-83 - AVE	101311	44800			29973	9705	185789
- %	54.5%	24.1%			16.1%	5.2%	100.0%
ONTARIO							
1979	27155	49926	34791			28563	140435
1980	34974	73143	32075		1805	29340	171337
1981	22089	41789	28530		1499	21671	115577
1982	35626	57780	30709		3153	31770	159038
1983	38722	53983	35278		2928	34283	165195
79-83 - AVE	31713	55324	32277		1877	29125	150317
- %	21.1%	36.8%	21.5%		1.2%	19.4%	100.0%
QUEBEC							
1979	2019	65708		7563		15927	91217
1980	3201	90550		8041		16726	118518
1981	114	33035		2038		10116	45304
1982	1618	56499		5937		14057	78110
1983	1296	42256		6687		14840	65079
79-83 - AVE	1650	57609		6053		14333	79645
- %	2.1%	72.3%		7.6%		18.0%	100.0%
N. B.							
1979		3429		1715		762	5906
1980		2858		1562		914	5334
1981		2667		1334		953	4953
1982		3239		1257		1505	6001
1983		3563		1810		914	6287
79-83 - AVE		3151		1536		1010	5696
- %		55.3%		27.0%		17.7%	100.0%
N. S.							
1979	4953	12383	4763	5715		18289	46104
1980	5715	13336	4763	5906		17432	47152
1981	5906	19051	4763	5334		19432	54486
1982	6192	19718	4763	7239		21147	59059
1983	5525	19051	3810	6477		18480	53343
79-83 - AVE	5658	16708	4572	6134		18956	52029
- %	10.9%	32.1%	8.8%	11.8%		36.4%	100.0%

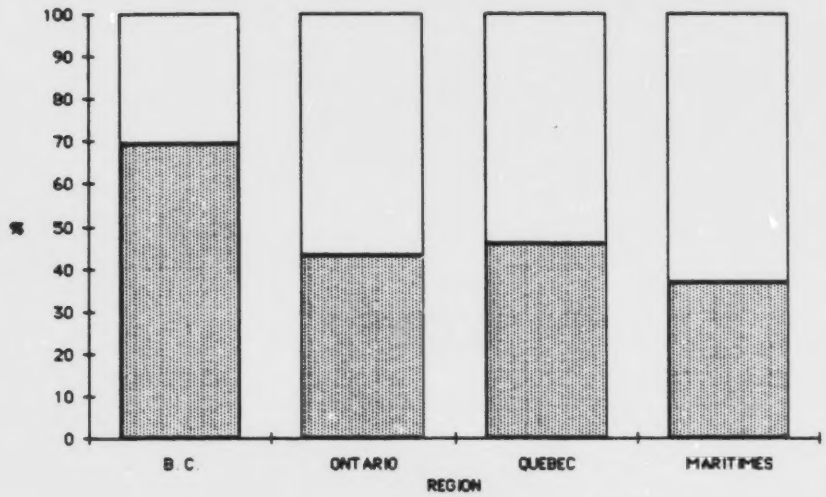
SOURCE: Statistics Canada Catalogue 22-003, Fruit and Vegetable Production.

Table I.5:- December 1 Storage Stocks of Apples by Region (Metric Tons)

YEAR	BRITISH COLUMBIA	ONTARIO	QUEBEC	MARITIMES	CANADA
1970	81310	60970	47469	23303	213052
1971	53801	63998	56582	27579	201960
1972	65788	53181	49558	18806	187334
1973	91402	32541	35910	19690	179543
1974	68604	51696	46513	21807	188620
1975	115819	51662	36435	25232	229148
1976	123172	41291	31104	19300	214868
1977	87816	47006	43852	17347	196021
1978	104520	60033	43123	20946	228622
1979	97898	60429	43621	18210	220157
1980	141085	79216	57995	18208	296503
1981	142359	51886	15224	20306	229775
1982	126038	68607	37529	26705	258880
1983	125607	67182	34527	21492	248809
1984	106594	57951	34580	22829	221954
STORAGE AVE. 80-84	128337	64968	35971	21908	251184
PRODUCTION AVE. 80-84	185385	150998	78417	59800	474600
STORAGE / PRODUCTION	69.2%	43.0%	45.9%	36.6%	52.9%

SOURCE: Agriculture Canada, Monthly Storage Holdings

FIGURE I.6: December First Apple Stocks as a Percent of Production, by Region



The same kinds of influences are also evident in storage data by variety as presented in Table I.6 and Figure I.7. The fresh market varieties (Delicious, Spartan, Cortland) have a higher proportion in storage than the varieties which are also suitable for processing (McIntosh and Spy).

The analysis presented above brings out a number of important considerations that bear directly on the feasibility of establishing juice concentrating facilities in Canada. A concentrating facility of sufficient size to allow reasonably efficient operation requires a substantial supply of apples. The plant described in Chapter III has an hourly capacity of about 6.6 tonnes of raw apples. Assuming an operating period of 14 hours per day and 160 days per season the plant would consume about fifteen thousand tonnes of apples per season. This represents approximately all of the apples currently juiced in Nova Scotia, half of those currently juiced in Quebec, one quarter of those currently juiced in Ontario, or one third of those currently juiced in British Columbia.

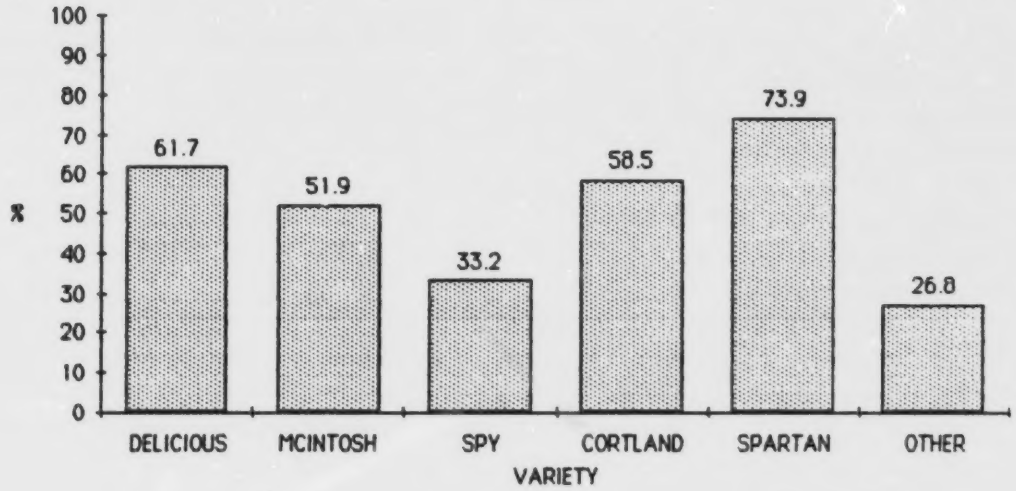
Although the varieties available in Nova Scotia would produce a high quality concentrate it would seem inappropriate to devote a very large proportion of processing apple availability to concentrating when an adequate market for "pure" juice exists. The marketing approach taken in B.C. and the varieties available for processing both detract from the desirability of a concentrating facility. The low cost storage that concentrate offers is not advantageous when cull apples are available throughout the season, and the

TABLE I.6: December First Storage Stocks of Apples by Variety (Metric Tons)

YEAR	DELICIOUS	MCINTOSH	SPY	CORTLAND	SPARTAN	OTHER	TOTAL
STORAGE	92812	86499	12982	8763	27025	20729	248809
PRODUCTION	150306	166564	39088	14974	36592	77334	484858
STORAGE / PRODUCTION	61.7%	51.9%	33.2%	58.5%	73.9%	26.8%	51.3%

SOURCE: Agriculture Canada, Monthly Storage Holdings

FIGURE I.7: December First Apple Stocks as a Percent of Production, by Variety



varieties grown would produce a low quality concentrate. Indeed, imported high-acid concentrates play an important role in enhancing the quality and marketability of juices produced from B. C. apples.

Ontario and Quebec have suitable varieties and sufficient production to support a concentrating facility but such a facility needs other justification when an adequate market for "pure" juice exists.

At an even more basic level the problem to be dealt with is how best to compete with imported concentrate. Even if Canadian apple production rises dramatically import substitution will be the most appropriate method of marketing the additional production. In that case, what are the alternatives available to the industry and what are their implications?

In the case of concentrated juice four alternatives are:

- increase juicing and canning capacity to allow additional production to be made into "pure" juice at harvest. This alternative has two disadvantages, facilities are only utilized for a brief period each year increasing fixed costs per unit of output, and inventory has a high value and, as a consequence, higher carrying costs.

- increase juicing and concentrating capacity to allow additional production to be made into concentrate at harvest. This alternative achieves low cost storage but involves the additional cost of concentration. It also means that canning facilities could be utilized throughout the year but juicing and concentrating facilities would be utilized only part of the year.

- increase raw apple storage capacity to allow for storage of a larger quantity of apples for processing. This alternative would allow for a better utilization of juicing and canning facilities but involves the additional cost of storing raw apples.

- increase juicing capacity and develop the capability to store pure juice in bulk. This alternative would allow for a better utilization of canning facilities and allow canners to produce a consistent product throughout the year. Bulk storage of pure juice is a relatively new procedure but has been used sucessfully by at least one Canadian processor.

The major advantages of imported concentrate are low cost, availability throughout the year (enabling canners to more fully utilize their equipment), and ability to maintain consistency in the product. The major disadvantage is that the product is reconstituted, must be identified as such, and is less acceptable to the consumer than "pure" juice.

II WORLD APPLE PRODUCTION AND TRADE

Estimates of world apple production in 1982 prepared by FAO are presented in Table II.1. Only those countries with production in excess of 100 kilotonnes are listed. Of the major suppliers of apple juice concentrates to Canada the U.S. ranks second among apple producers, West Germany fifth, Hungary nineth, Argentina thirteenth, Austria twenty-third, South Africa twenty-fifth, and Chile twenty-eighth.

Countries which have experienced major increases in production over the last ten years include Egypt, South Africa, Argentina, Brazil, Chile, Ecuador, China, India, Iran, Iraq, Israel, Syria, Turkey, Austria, Hungary, and Romania.

In terms of trade France, Italy, the United States, Argentina, the Netherlands, South Africa, and Chile account for over 75% of all exports of fresh apples from market economies.

Although FAO does not report trade in apple juice as a separate commodity, exports of "fruit and vegetable juice" (excludes orange juice) give an indication of the major players in the international market. Brazil, the United States, Italy, Israil, West Germany, the Netherlands, Argentina, France, Greece, and Austria account for over 80% of all exports of fruit and vegetable juices (excluding orange juice) from market economies. Brazil is by far the largest exporter, accounting for about one third of exports from market economies. Brazil is also a very important factor in the international orange juice market, accounting for over 50% of exports from market economies.

Brazil's role in the apple juice market is not as important as the trade statistics for fruit and vegetable juice imply and its position as the major exporter of fruit and vegetable juices is probably due to exports of citrus juices other than orange juice.

The production and trade data shows that the United States, South America (Argentina and Chile), Central and Eastern Europe (West Germany, Austria, Hungary, Romania, etc.), and South Africa represent the major surplus production areas amongst the market economies.

The countries of major interest in the current context are those supplying significant quantities of concentrated apple juice to the Canadian market. On the basis of shares of total concentrate imports from 1976 to 1983 the most important suppliers were Argentina (21% of imports), South Africa (19%), the United States (12%), Austria (8%), Chile (7%), Hungary (7%), and

TABLE II.1: Apple Production by Country, 1982 (000 Metric Tons)

USSR	7400
USA	3724
CHINA	3022
FRANCE	3016
W GERMANY	2775
ITALY	2200
POLAND	1893
TURKEY	1257
HUNGARY	1000
JAPAN	927
SPAIN	913
INDIA	850
ARGENTINA	828
YUGOSLAVIA	667
E GERMANY	577
S KOREA	527
CZECHOSLOVAKIA	504
N KOREA	500
NETHERLANDS	470
CANADA	464
IRAN	460
SWITZERLAND	450
AUSTRIA	429
ROMANIA	410
SOUTH AFRICA	400
BULGARIA	392
UK	373
CHILE	350
AUSTRALIA	294
BELGIUM/LUX	270
GREECE	257
NEW ZEALAND	228
MEXICO	180
ISRAEL	130
LEBANON	130
BRASIL	120
DENMARK	120
IRAQ	110
PAKISTAN	105
PORTUGAL	105
SYRIA	104

SOURCE: FAO PRODUCTION YEARBOOK

West Germany (6%). Information on production, imports and exports of fresh apples, and processing utilization for these countries and several others is presented in Tables II.2 and Table II.3. A summary of available information on the apple industry in general and juice concentrating activity in particular in these countries follows.

TABLE II.2: Apple Supply and Utilization in Selected Southern Hemisphere Countries (Metric Tons)

COUNTRY	YEAR 1/	PRODUCTION	IMPORTS	EXPORTS FRESH	PROCESSING
ARGENTINA	1983	817,000	0	220,475	330,000
	1984	934,000	0	200,000	400,000
	1985	950,000	0	220,000	380,000
AUSTRALIA	1983	301,000	0	33,000	102,000
	1984	281,000	0	15,000	85,000
	1985	320,000	0	34,000	88,221
CHILE	1983	370,000	0	179,295	30,000
	1984	410,000	0	208,000	35,000
	1985	480,000	0	230,000	40,000
NEW ZEALAND	1983	191,715	4,255	90,854	70,381
	1984	233,026	2,775	127,021	71,580
	1985	246,050	2,500	133,200	77,150
SOUTH AFRICA	1983	423,396	359	143,896	117,500
	1984	502,110	350	231,097	119,500
	1985	494,318	350	198,727	122,000
TOTAL	1983	2,103,111	4,614	667,520	649,881
	1984	2,360,136	3,125	781,118	711,080
	1985	2,490,368	2,850	815,927	707,371

1/ Harvest and marketing occur entirely during the year shown.

SOURCE: Reports from U.S. Agricultural Counselors and Attaches.

TABLE II.3: Apple Supply and Utilization in Selected Northern Hemisphere Countries (Metric Tons)

COUNTRY	YEAR 1/	PRODUCTION 2/	IMPORTS	EXPORTS FRESH	PROCESSING	WITHDRAWAL
AUSTRIA	1982/83	339,500	14,000	0	59,500	0
	1983/84	263,000	18,400	0	6,400	0
	1984/85	276,300	17,000	0	15,300	0
BELGIUM-LUX.	1982/83	270,324	122,469	67,230	54,065	30,394
	1983/84	203,416	130,000	70,886	30,512	300
	1984/85	230,480	125,000	70,000	46,096	?,000
CANADA	1982/83	477,626	95,392	63,597	187,404	0
	1983/84	484,853	91,288	77,352	211,378	0
	1984/85	455,435	100,000	65,000	200,000	0
DENMARK	1982/83	59,462	40,346	10,566	30,000	0
	1983/84	47,159	42,583	6,022	15,000	0
	1984/85	67,000	40,000	10,000	30,000	0
FRANCE	1982/83	1,977,500	88,000	614,000	170,000	357,000
	1983/84	1,572,600	122,400	546,100	185,000	0
	1984/85	1,930,000	90,000	600,000	200,000	270,000
GERMANY (FRG)	1982/83	2,637,089	499,571	45,772	805,370	93,700
	1983/84	1,313,071	716,618	51,545	410,297	0
	1984/85	1,799,269	670,000	55,000	501,800	300
GREECE	1982/83	265,000	0	5,000	25,000	32,000
	1983/84	311,000	0	8,000	35,000	26,000
	1984/85	320,000	0	10,000	35,000	22,000
ITALY	1982/83	2,642,200	46,500	290,000	250,000	957,700
	1983/84	2,055,600	70,840	380,300	250,000	450,000
	1984/85	2,075,000	58,000	340,000	250,000	470,000
JAPAN	1982/83	923,500	0	2,200	167,000	51,600
	1983/84	1,048,000	0	6,200	196,500	66,400
	1984/85	985,700	0	7,000	163,500	58,700
MEXICO	1982/83	394,400	3,539	10	68,500	0
	1983/84	302,400	1,017	50	39,450	0
	1984/85	437,000	816	11	76,805	0
NETHERLANDS	1982/83	440,000	188,000	140,000	80,000	58,000
	1983/84	364,000	218,000	154,000	86,000	0
	1984/85	380,000	200,000	150,000	80,000	13,000
NORWAY	1982/83	43,673	45,875	0	8,700	0
	1983/84	50,646	38,782	0	10,000	0
	1984/85	50,441	39,000	0	8,000	0
SPAIN	1982/83	891,000	10,000	16,000	45,000	0
	1983/84	1,047,000	560	56,150	50,000	0
	1984/85	1,049,000	500	40,000	70,000	0
SWEDEN	1982/83	42,500	64,011	2,058	5,000	0
	1983/84	42,000	62,590	3,671	5,500	0
	1984/85	36,800	70,000	4,000	6,000	0
SWITZERLAND	1982/83	139,800	2,610	457	52,710	0
	1983/84	99,200	29,239	30	15,930	0
	1984/85	124,900	10,000	50	30,000	0
UNITED KINGDOM	1982/83	340,300	393,600	20,000	100,000	0
	1983/84	292,500	489,267	21,761	100,000	1,000
	1984/85	311,600	475,000	20,000	100,000	0
UNITED STATES	1982/83	3,684,060	88,148	273,298	1,620,929	0
	1983/84	3,797,910	104,406	222,360	1,693,096	0
	1984/85	3,729,420	111,883	200,120	1,640,944	
YUGOSLAVIA	1982/83	746,000	0	20,000	250,000	0
	1983/84	557,000	0	50,000	160,000	0
	1984/85	607,000	0	50,000	180,000	0
TOTAL	1982/83	16,313,934	1,702,061	1,570,188	3,974,128	1,580,394
	1983/84	13,851,355	2,135,990	1,654,427	3,490,063	542,700
	1984/85	14,865,345	2,007,199	1,621,181	3,633,445	836,000

1/ July-June crop years. 2/ Production data refer only to the commercial crop in the following countries: Canada, United States, Belgium-Luxembourg, Denmark, Netherlands, and Switzerland. 3/ All 1984/85 data are preliminary.

SOURCE: Crop Reporting Board and Bureau of Census for the United States. Reports from U.S. Agricultural Counselors and Attaches.

ARGENTINA

The information in this section is an adaptation and updating of the article "The Apple Juice Industry of Argentina" by Kathleen Moore in U.S.D.A's Foreign Agriculture Circular.

Argentina's apple production is concentrated in Western Argentina, especially in the Rio Negro Valley, about 1,200 km southwest of Buenos Aires (see Figure II.1). The province of Rio Negro contributes roughly 70 percent of the total crop, and the nearby provinces of Nequen and Mendosa account for much of the balance. The combined production of these three areas is over 95 percent of total production in Argentina.

TABLE II.4: Apple Production in Argentina, by Province (Metric Tons)

Province	1981	1982
Rio Negro	648,200	576,000
Neuquen	113,200	120,000
Mendoza	116,200	82,500
Others	30,400	25,500
Total	908,000	804,000

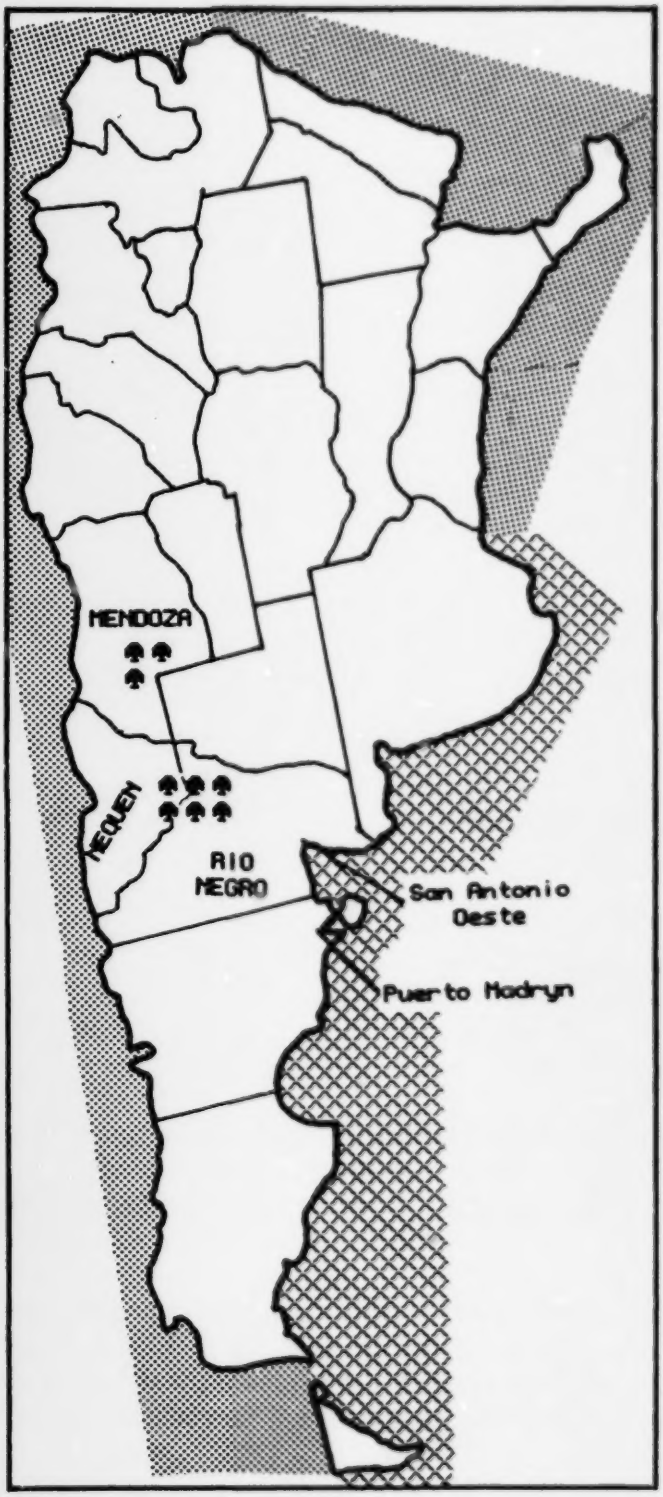
Source: Argentina, Secretaria de Estado de Agricultura y Ganaderia

Total Argentine apple production was 817,000 metric tons in 1983, 943,000 in 1984, and is estimated at 950,000 in 1985. The production, processing and marketing of apples and other deciduous fruit dominates the provincial economies of Rio Negro and Nequen, both of which are in the Rio Negro Valley producing area.

Apple production in Argentina has stabilized. Under optimum conditions the country's output would be about one million tons. Non-bearing apple area was 3,550 hectares in 1982, about 6 percent of the total area planted with apples.

The majority of the apples are grown on farms averaging between 5 and 15 hectares. Irrigation is required. The predominant method is flood irrigation by furrows, as the network of rivers provides a plentiful supply of water and the soil has good drainage. Orchards are surrounded by poplars which

FIGURE II.1: Major Apple Growing Regions in Argentina



provide protection from the intense winds and furnish lumber for packing crates.

All newer plantings utilize the spalding technique in which dwarf trees are trained on wires in a hedge manner. The advantages are ease of harvesting, fertilizer and pesticide application, and increased yields. The dwarf trees are more securely trained in this fashion, particularly from the strong prevailing winds.

The Red Delicious and Granny Smith varieties now dominate Argentine apple production. In Rio Negro and Nequen they account for about 55 and 33 percent respectively of total output. Rome Beauty is the most important remaining variety but many other types are grown including Red Spur, Black Winesap, Golden Delicious, and King David.

Most of the new plantings are red delicious cultivars, notably Spur Lisa, a full coloured apple; and Rayada, a striped spur. New plantings of a Granny Smith cultivar, Granny Spur, have occured, in part because the self pollinating Granny is interplanted with the red varieties which require pollinators.

Apple Marketing

The emphasis of the Argentine industry is on the marketing of fresh apples, which command much higher prices than apples utilized for processing. Approximate grower returns in U.S. dollar equivalence for the 1983 season were $160 to $230 per metric ton for fresh utilization and $45 to $80 per ton for processed utilization.

The fresh market is the outlet preferred by Argentine growers. Some growers claim the present levels of returns from processing are far below the cost of production. The processing industry has, nevertheless, prospered and grown because of declining exports of fresh apples, an increase in the proportion of cull apples as growers cut back on outlays for pesticide application and other cultural practices, and finally, the growing international market for concentrated apple juice.

In recent years about 30 percent of Argentina's apple production has been destined for fresh export markets, about 30 percent for the fresh domestic market, about 30 percent for concentrated apple juice, and approximately 10 percent is used for producing alcoholic apple cider for the domestic market. These percentages, however, vary from year to year along with variations in the size and quality of domestic and foreign crops.

The relative importance of Red Delicious and Granny Smith apples by market outlet is shown in Table II.5.

TABLE II.5: Market Outlets for Argentine Apples in 1981 (percent of total production)

Variety	Fresh		Processing
	Export	Domestic	
Red Delicious	57	68	49
Granny Smith	34	22	37
Other	9	10	14
TOTAL	100	100	100

Source: Calculated from data prepared by Province of Rio Negro, Secretaria de Planeamiento, and CFA, #285, magazine published by Corporacion Fruticula Argentina.

In 1981, the processing sector in the two provinces utilized approximately 42 percent of total Red Delicious production, 55 percent of the Granny Smiths, and 56 percent of other varieties.

The Red Delicious is Argentina's premier apple for fresh consumption, both in the domestic and export markets. It is the preferred variety in Brazil, the leading Argentine export market. Granny Smith is the leading export variety to European markets, and because of its high acidity, the choice apple of the processing sector.

However, Argentina's fresh export markets are becoming increasingly difficult to maintain. Brazil has imposed more stringent import regulations in an effort to conserve foreign exchange and protect an expanding domestic industry. European imports are not growing. Argentine exporters are exploring possible markets in the Far East and the Middle East as well as the United States.

Industry sources feel the domestic market has much potential. Negligence of this market is acknowledged, and attempts are being made to improve the promotion and distribution of apples for domestic consumption. Buenos Aires is virtually the only well developed domestic market principally because of a lack of cold storage facilities in other potential market areas.

Apple Juice Production

Argentine concentrated apple juice is produced from the culls of the packing houses. The process varies only slightly among the various facilities. The apples are ground and pressed, the essence is stripped from the raw juice which is then treated for starch and pectin removal, filtered, condensed to proper concentration, cooled, and drained. Some plants re-introduce the essence with the concentrate, others prefer not to. The concentrate is kept in cold storage (5°C) to prevent browning and to enable the product to travel as unrefrigerated cargo to its export destination. Although processing yields may vary slightly from year to year and plant to plant, on the average one metric ton of raw fruit yields 20.03 U.S. gallons of 71° Brix concentrate.

Concentrated apple juice production in Argentina is a relatively young industry, having begun in the late 1960's. Today the country boasts 14 companies operating 16 processing plants with evaporation capacity. Thirteen plants are located in Rio Negro and three in Nequen. In addition, about a dozen small firms grind and press fruit which is sold to the major plants for evaporation.

No one firm dominates the industry. The largest company produces less than 20% of total output. Total capacity of all the firms is reportedly close to 600,000 tons of fresh fruit, or about twice the amount currently being processed.

TABLE II.6: Argentine Production of Concentrated Apple Juice (Metric Tons)

Year	Production
1977	22,500
1978	25,500
1979	36,000
1980	39,000
1981	27,000
1982	27,700
1983	30,000
1984	37,000

Source: Food News and U.S. Agricultural Counselor

The plants operate year round but 70 to 80 percent of concentrate production occurs during the February to May period. During the latter part

of the year the plants are processing fruit rejected from cold storage. Table II.7 illustrates the seasonality of production and marketing. Marketings (exports) are heaviest in the March to July period.

TABLE II.7: Supply and Disposition of Concentrated Apple Juice, Rio Negro Province, 1981 (Metric Tons)

Month	Beginning Stocks	Production	Marketing	Ending Stocks
January	5,379	389	2,016	3,752
February	3,752	1,671	1,076	4,347
March	4,347	4,646	2,506	6,487
April	6,487	4,736	4,456	6,767
May	6,767	4,019	4,734	6,052
June	6,052	1,201	2,056	5,206
July	5,206	1,193	2,061	4,338
August	4,338	507	770	4,075
September	4,075	387	383	4,079
October	4,079	369	1,898	2,550
November	2,550	131	1,293	1,388
December	1,388	88	455	1,021

Source: Province of Rio Negro, Secretaria de Planeamiento

The cost of producing a U.S. gallon of concentrate during the 1983 season was roughly $U.S. 4.40. This includes labour, energy, fuel, clarifying agents, filtering aids, packaging, and apples at $U.S. 60 per metric ton. However, it is a common complaint among processors that their costs can never be accurately assessed due to the high rate of inflation and the rapid devaluation of the peso.

Most of the concentrate is packaged for export in 58 gallon drums. A high density, high molecular weight polyethylene is imported to construct these containers and is blown into drums locally. Each brum costs about $U.S. 30.

Apple Juice Marketing

The concentrate moves in unrefrigerated trucks from the processing facilities to the port. Land freight rates for concentrate in drums during March 1983 were $U.S. 23 per metric ton for shipments from Cipolletti, Rio Negro to Buenos Aires and $U.S. 29 per ton for shipments to Puerto Madryn. Rates to San Antonio Oeste are expected to be somewhat lower. Approximate

ocean freight rates for apple concentrate in drums were $U.S. 130 per metric ton from Buenos Aires to the U.S. East Coast and $165 from Puerto Madryn or San Antonio Oeste to the U.S. East Coast.

After mid-1983, most of Argentina's concentrate is expected to be exported from the new facilities at the port of San Antonio Oeste, replacing Puerto Madryn as the principal port of embarkation. Concentrate exports from both of these ports presently are entitled to a 6 percent export rebate, which compensates for the higher ocean freight. Concentrate exported through Buenos Aires and other ports is currently subject to a tax of 1%. San Antonio Oeste is located 460 kilometers east of Cipolletti, the center of the apple growing area in the Rio Negro Valley.

In addition to export rebates, concentrate exporters are eligable for pre-export financing covering 60 percent of the FOB value of their product. These loans must be repaid in 120 days. The monthly interest rate is 7 percent, which is well below the commercial loan rate of 11 percent per month. Further, since January 1981 producers have been eligable for interest free dollar denominated loans equivalent to $U.S. 180.00 per metric ton of concentrate exported. These loans are to be repaid within 10 years with a grace period of 2 years.

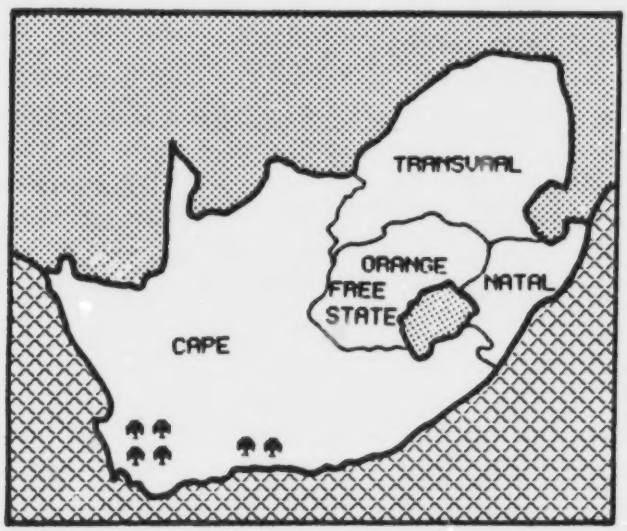
Partially offsetting these subsidies and incentives are the uncertainties created by Argentina's inflation of about 200 percent per year, rapid currency devaluation, and lack of continuity in government economic policies.

The United States usually receives about 85 percent of Argentine apple juice concentrate exports. Although the processors are in a seemingly precarious situation, essentially dependent on the U.S. market, there are few attempts made at diversifying export markets. U.S. consumption of apple juice has risen substantially since the onset of the Argentine exports, yet the Argentine processors believe that it has not reached its saturation point. Further, apple juice imports are currently afforded duty free access to the United States. This is in sharp contrast to the 42 percent ad valorem duty in the European Community. Canada, Sweden, Norway, Brazil, and Venezuela are considered minor markets. The Argentine domestic market currently absorbs no more than 3 or 4 percent of concentrate production.

SOUTH AFRICA

Apple production in South Africa is concentrated in southern Cape province (see Figure II.2). Production, fresh exports and processing utilization from 1981 to 1984 are shown in Table II.8. Approximately 40 % of South African apple production is exported fresh and an additional 25 % is used in processing.

FIGURE II.2: Major Apple Growing Areas of South Africa



Apple production for fresh markets is projected to increase by 15% over the decade (from 1985 to 1995). The most significant increase is expected in the production of the Topred cultivar. The Granny Smith cultivar currently represents over 40% of production and is expected to maintain that position over the next decade.

Production of concentrated apple juice has grown steadily in recent years and reached 14,500 Metric Tons in 1984.

TABLE II.8: Current and Projected Production of Fresh Market Apples in South Africa, by Cultivar (percent of total production)

Variety	Current (1985)	Projected (1995)
Red		
Starking	19%	14%
Topred	5%	15%
Starkrimson	4%	5%
Other		
Granny Smith	47%	43%
Golden Delicious	22%	20%
Other	3%	3%

Source: South African Apple Growers Association

TABLE II.9: Apple Production, Fresh Exports, and Processing Utilization in South Africa (Metric Tons)

Year	Production	Exports	Processed
1981	450,000	168,000	117,000
1982	486,000	222,000	113,000
1983	423,000	144,000	117,500
1984	502,000	231,000	119,500

Source: Foreign Agricultural Circular, U.S.D.A.

UNITED STATES OF AMERICA

Production of Apples in the U.S. varies between 3.5 and 4 million metric tons per year. Approximately 45 % of the crop is used for processing and approximately half of processed apples are used in the production of juice.

TABLE II.10: United States Production and Processing of Apples (Thousand Metric Tons)

Crop Year	Production	Processed (%)	Juiced (%)
1978	3,446	1,512 (44)	678 (20)
1979	3,694	1,729 (47)	886 (24)
1980	4,005	1,754 (44)	969 (24)
1981	3,517	1,475 (42)	816 (23)
1982	3,684	1,621 (44)	820 (22)
1983	3,798	1,693 (45)	900 (24)
1984	3,729	1,641 (44)	837 (22)

Source: Crop Reporting Board, U.S.D.A.

Imports of concentrated apple juice have increased rapidly over the last 20 years. The U.S. represents a huge market and is by far the most important customer for a number of exporting countries. In 1984/85 imported concentrates are expected to account for over 50 % of apple juice consumption in the United States.

TABLE II.11: Estimated Supplies of Apple Juice in the United States (Million Litres).

Crop Year	Domestic Production	Imports	Total Supply	Import Share of Supply
1980	645	266	911	29 %
1981	543	289	832	34 %
1982	546	529	1,075	49 %
1983	599	550	1,149	48 %
1984	557	692	1,250	55 %

Source: Crop Reporting Board, U.S.D.A. and Dept. of Commerce

Although Canadian import statistics show the United States as a major supplier of apple juice concentrates, the bulk of U.S. exports are thought to be trans-shipments of South American concentrates rather than domestic production.

AUSTRIA

Although Austria is not a significant producer of apples and a relatively small proportion (about 25 %) of the crop is used for processing it is an important supplier of concentrated apple juice to the North American market. Concentrate imported in bond from Eastern Europe for re-export accounts for the majority of Austrian exports. In 1983, concentrate exports reached 27,400 metric tons of which only 5,000 were processed from the domestic crop. An estimated 83 percent of 1984/85 exports will be supplied from bonded imports.

TABLE II.12: Apple Production, Fresh Exports, and Processing Utilization in Austria (Metric Tons)

Year	Production	Exports	Processed
1980/81	240,000	0	81,000
1981/82	186,000	0	52,000
1982/83	339,555	0	59,500
1983/84	263,000	0	6,400

Source: Foreign Agricultural Circular, U.S.D.A.

CHILE

Apple production in Chile is export oriented with more than half of the crop normally exported as fresh apples. Granny Smith and Richardred Delicious each account for about 25 % of apple orchard acreage but other important varieties are Red King Oregon, Starking Delicious, and Red Spur. The Granny Smith variety accounts for about 60 % of exports, Richardred Delicious for about 30%, and other varieties for the remaining 10 %. A very small proportion of the crop (about 10 %) is processed. Although apples are produced throughout Chile the major producing areas are in the provinces of O'Higgins, Colchagua, and Curico just south of Santiago in central Chile.

TABLE II.13: Apple Production, Fresh Exports, and Processing Utilization in Chile (Metric Tons)

Year	Production	Exports	Processed
1981	298,000	187,000	12,000
1982	335,000	182,000	40,000
1983	370,000	179,000	30,000
1984	410,000	208,000	35,000

Source: Foreign Agricultural Circular, U.S.D.A.

WEST GERMANY

West Germany is an important apple producer and at the same time imports significant quantities of fresh apples and apple juice concentrate.

TABLE II.14: Apple Production, Fresh Exports, Processing Utilization, and Imports in West Germany (Metric Tons)

Year	Production	Exports	Processed	Imports
1980/81	1,880,000	25,000	499,000	n/a
1981/82	773,000	25,000	204,000	n/a
1982/83	2,637,000	45,500	805,000	499,500
1983/84	1,313,000	51,500	410,000	716,500

Source: Foreign Agricultural Circular, U.S.D.A.

Although apple production takes place throughout Germany the main producing areas are the province of Niedersachen in Northern Germany, and Baden-Wurtemberg in Southern Germany.

Imports of fresh apples and concentrated juice are mainly from East European countries. Some fresh apple imports are processed into juice and imports of concentrate are re-exported. Production of concentrate has varied widely over the last few years in step with wide fluctuations in apple production.

Most of the concentrate exported from West Germany is destined to U.S. and Canadian markets.

TABLE II.15: Geographic Distribution of 1983 Apple Production in West Germany (Metric Tons)

Northern Germany:		
Schleswig-Holstein	53,588	
Hamburg	48,529	
Niedersachen	368,329	
Bremen	5,704	
TOTAL		476,150
West Germany:		
Hessen	46,277	
Rhineland-Pfalz	41,794	
Saarland	10,786	
Other	147,242	
TOTAL		246,099
Southern Germany:		
Baden-Wuerttemberg	432,156	
Bavaria	132,495	
TOTAL		564,651
West Berlin		26,171
TOTAL		1,313,071

TABLE II.16: West German Production of Apple Juice Concentrate (Metric Tons)

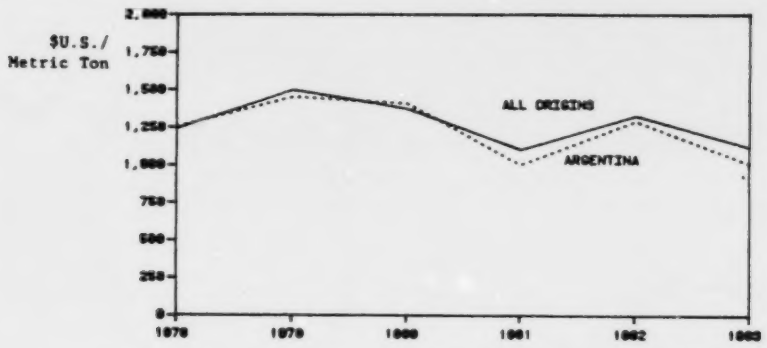
Year	Production
1979/80	38,817
1980/81	46,989
1981/82	20,940
1982/83	88,306
1983/84	38,306
1984/85	46,370

Source: Foreign Agriculture Circular, U.S.D.A.

SUMMARY

The global market for concentrated apple juice can be characterized as being under pressure. Increasing supplies of concentrate are being made available and prices have been under pressure (see Figure II.3). At the same time the ability of the world market to absorb increasing supplies depends on continuance of a number of favourable but unreliable trends in major importing countries, particularly the United States.

FIGURE II.3: Average Apple Juice Concentrate Prices ($U.S./Metric Ton)



Source: U.S.D.A., Foreign Agricultural Circular, Horticultural Products

On the supply side planned expansion of apple production in the major exporting countries of the southern hemisphere will mean increased supplies of concentrate on world markets. In addition, loss of fresh apple markets in Latin America and increasing competition for EEC fresh apple markets has caused more production to be diverted to processing.

On the demand side the most important question is what will happen in the U.S. market. The United States is by far the largest importer of concentrate. Apple juice consumption has been expanding rapidly in the U.S. with most of the increase being supplied by imported concentrates. The ability of the U. S. market to absorb steadily increasing supplies of concentrate depends on continued increases in demand for apple juice, and a strong U.S. dollar to maintain the price advantage currently enjoyed by imported product. In addition, the U.S. is in the process of placing a nominal tariff on concentrate imports. While the proposed tariff is too small to create a significant barrier to imports, it will allow the International Trade Commission to take countervail action in cases where it feels imported concentrate prices reflect production or export subsidies. The U.S. is becoming much more aggressive in trade matters as evidenced by recent actions to counteract perceived subsidies in Canadian hog production and in EEC grain exports.

III COSTS OF MANUFACTURING APPLE JUICE CONCENTRATE

This section describes the processing and equipment requirements and gives estimated costs for manufacturing high-density (71 Brix) concentrated apple juice.

The facilities and process envisaged are based on a study by the Agricultural Research Service of the United States Department of Agriculture [13]. It represents a scale of operations large enough, but no larger than necessary, to achieve reasonable economies of operation. The cost estimates presented here are based on informal consultation with equipment suppliers, management of a concentrating facility, and a commercial-industrial building contractor. The estimates are presented as a guide only. Construction and equipment costs are highly dependent on specific site and process variables that can only be considered in general terms here.

A breakeven analysis shows how the cost information can be used to evaluate the impact of throughput, prices paid for raw apples, and prices received for concentrate on operating results.

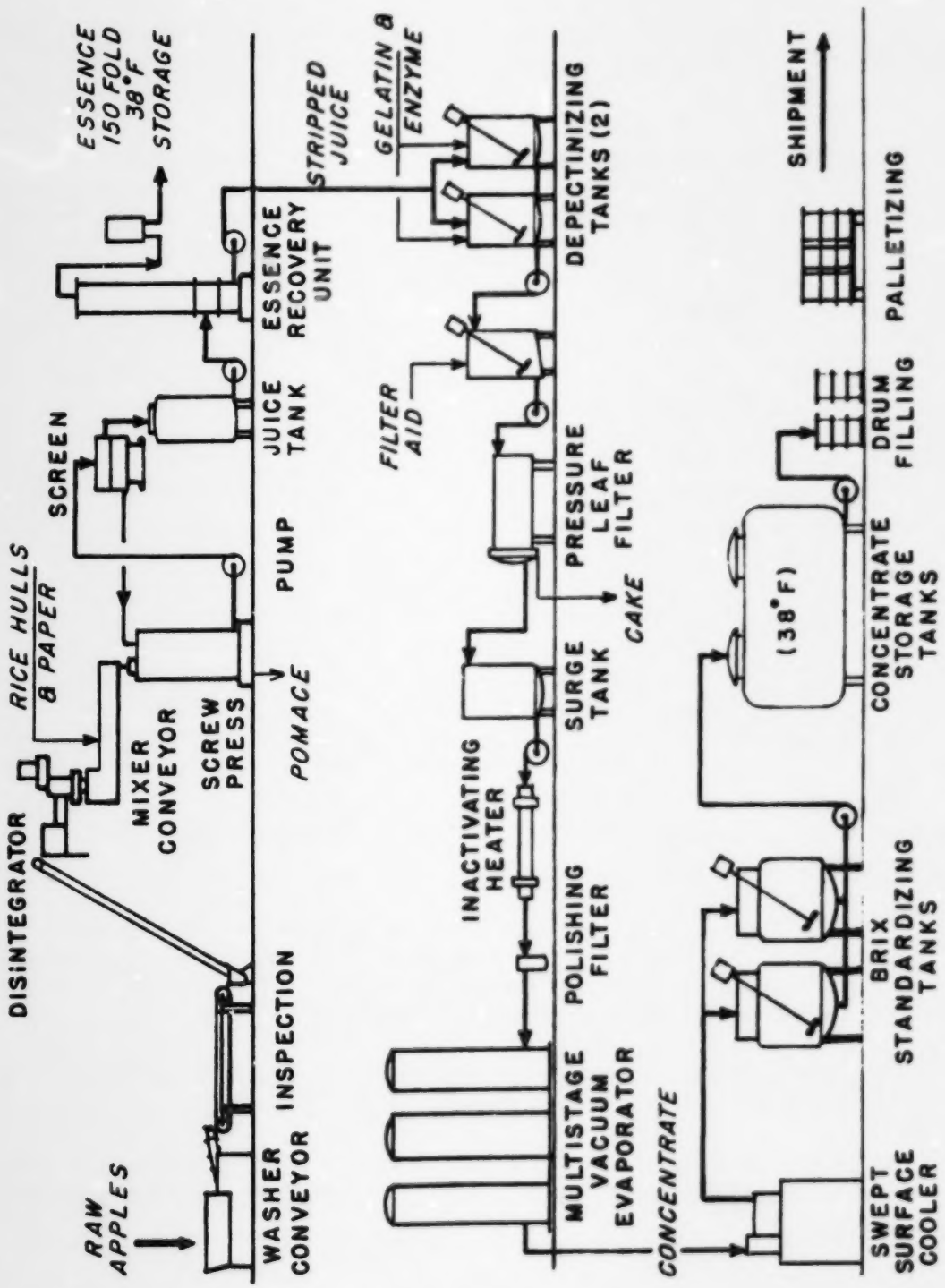
The plant envisioned here starts with raw apples, converts them to single strength juice, and then to apple juice concentrate. In any specific situation, particularly where an established apple packer or processor decides to manufacture concentrate, some of the needed facilities such as land, building space, and boiler capacity could well be available. However, since the extent to which such facilities are already available to potential manufacturers are not known, the cost estimates presented here assume that no production facilities are available and that a complete plant would be built from the ground up.

Obviously a plant is best located in an area where ample quantities of apples are normally available for processing. The plant proposed here would require an input of about 6.6 tonnes per hour or 1850 tonnes per month assuming 20 processing days of 14 hours in a month.

The processing steps envisaged and the equipment required are depicted in Figure III.1. A list of the processing equipment is given in the next section.

The hourly capacity of the plant is 750 kg of 71 Brix concentrate. This requires a single strength juicing capacity of 4620 kg per hour assuming

FIGURE III.1: Process for Manufacturing Apple Juice Concentrate and Essence



that the juice produced averages 11.5 Brix. At 70 % yield of juice 6.6 tonnes of apples per hour would be required to supply the plant.

For the cost estimates the plant is assumed to operate for two eight hour shifts (16 hours per day) and five days per week. On a daily basis, it is assumed that 14 hours of production would be obtained with 2 hours devoted to startup, shutdown, and cleaning operations.

PROCESSING EQUIPMENT AND BUILDINGS REQUIRED

A list of the equipment required with a brief description of each item and its estimated cost is given below:

PLANT AND EQUIPMENT

1) Forklift trucks, one for handling drums, one for moving containers of raw apples. 2@$15,000 30,000
2) Dumper for Apple Bins 4,000
3) Water-filled concrete pit into which apples are dumped for washing 6,000
4) Elevator to lift apples from washing pit 15,000
5) Washing and inspection conveyor-powered rollers and water sprays 4,000
6) Equipment purchased as a "package" unit, from discharge of inspection conveyor to discharge of apple press. Includes screw conveyor, disintegrator, handling and metering equipment for pressing aids, paper chopper, etc, with automated controls 125,000
7) Pomace conveyor system 4,000
8) Vibrating screen for screening solids from juice, 100 to 150 mesh 4,000
9) Juice-feed tank for essence recovery unit, 1,000 litre, stainless steel 3,000
10) Essence recovery unit 35,000
11) Essence receiving and holding tank, 400 litre, jacketed stainless steel 4,500
12) Essence pump, stainless steel 1,000
13) Stripped juice pump 1,500
14) Depectinizing tanks, agitated, stainless steel, 11,000 litre. 2@$10,000 20,000

15) Pump for depectinized juice	1,500	
16) Filter-feed tank (same type as item 14)	10,000	
17) Pressure-leaf filter, stainless steel, 180 square feet of filtering area	20,000	
18) Holding tank for filtrate, stainless steel, 4000 litre, open top	4,000	
19) Inactivating heater for juice (to destroy pectinase enzyme)	1,800	
20) Polishing filter (to remove any solids before evaporator)	3,000	
21) Vacuum evaporator (to evaporate 1,500 kg of water per hour	150,000	
22) Swept-surface cooler (to cool concentrate from the evaporator)	15,000	
23) Brix standardizing tanks, 1000 litre, jacketed for cooling, agitated. 2@$6,500	13,000	
24) Concentrate pump	3,000	
25) Concentrate storage tanks, 150,000 litre, horizontal type, epoxy-lined carbon steel, located in refrigerated room. 3@$40,000	120,000	
26) Refrigeration system, 15 tons	35,000	
27) Boiler (6,000 lbs of steam per hour)	80,000	
(TOTAL EQUIPMENT		$713,300)
28) Building to contain processing equipment. 5000 square feet @ $25.00 per square foot	125,000	
29) Refrigerated room for concentrate storage tanks (40 by 70 by 20 feet high)	86,000	
30) Boiler room 600 square feet @ $25.00	15,000	
31) Land and site preparation	15,000	
32) Sundry. Includes equipment installation, piping, insulation, electrical, instrumentation, office equipment, contractor's fee, engineering costs, and contingency allowance	500,000	
(TOTAL BUILDINGS		$741,000)
TOTAL CAPITAL COST		$1,454,300

OPERATING COSTS

Operating costs have been divided into variable costs which are expressed as dollars per productive hour and as cents per kg of concentrate produced, and fixed costs which are expressed in dollars per year. Depreciation is calculated by the straight line method.

Variable Costs

ITEM	DOLLARS PER HOUR	CENTS PER KG
Materials and Supplies		
Apples (6.6 tonnes/hr @ .11/kg)	726.00	96.8
Paper pulp, rice hulls, depectinizing enzyme, gelatin, filter aid	15.00	2.0
Packaging		
Reconditioned 55 gallon drum, plastic liner ($8.50 per drum)	22.77	3.0
Operating Labour		
Four operators per shift @ 10.00/hr (including benefits)	45.70	5.3
Utilities		
Steam (5500 lbs/hr @ $5.00/1000 lbs)	27.50	3.6
Electricity (100 KWH/hr @ 4.5¢/KWH)	4.50	0.6
Water (100 cubic metres/hr @ 18¢ per cubic metre)	18.00	2.4
TOTAL VARIABLE COSTS	859.47	113.7

Fixed Costs

Management and Administrative Personnel	
Two shift supervisors	40,000
Mechanic	25,000
Shipper/receiver	20,000
Office Manager	25,000
Secretary	15,000
Benefits	30,000
Maintenance, Repairs and Operating Supplies (3.25 % of fixed capital)	47,265
Insurance and Taxes (2.25 % of fixed capital)	32,722
Administrative Expenses	20,000
Interest on Working Capital (12% on $300,000)	36,000

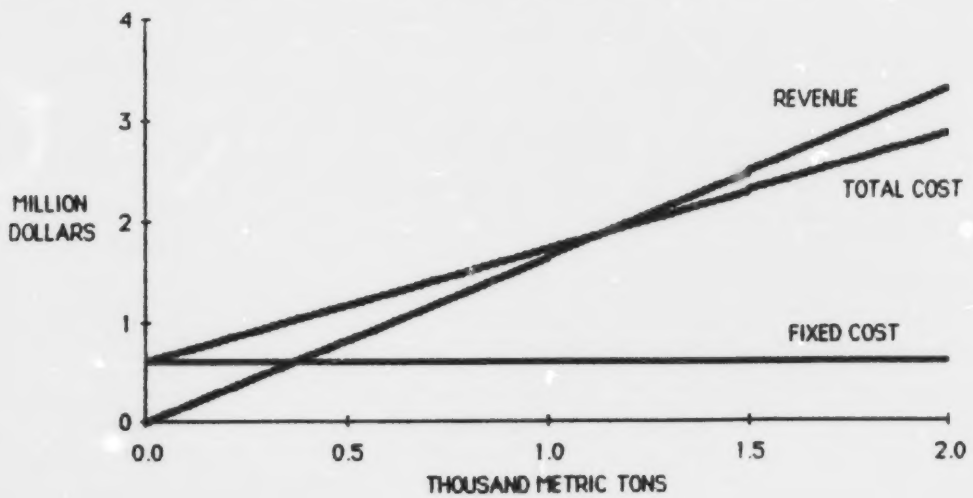
Depreciation	
Equipment ($713,300 with 10 year life)	71,330
Buildings ($741,000 with 25 year life)	29,640
Return on Investment (15% on $1,454,300)	218,145
TOTAL FIXED (ANNUAL) COSTS	$610,102

BREAKEVEN ANALYSIS

Apple juice concentrate prices on the international market have fluctuated between 1000 and 1500 dollars U.S. per metric ton over the last few years. If a price of $1270 is chosen (U.S.$6.50/U.S. gallon) then the price of imported concentrate in Canadian currency will be about $1670 per metric ton. Figure III.2 shows the breakeven analysis based on this price and the fixed and variable costs of operating the plant described above. The analysis shows that at an annual production of 500 metric tons which is roughly equivalent to two months of operation at 14 hours per day, the cost of producing concentrate is $2360 per metric ton. If the plant were operated on the same basis over a period of seven months, the per tonne cost of concentrate produced would drop to $1550. The breakeven point occurs at a production of approximately 1,200 metric tons (four months of operation).

In practice the plant would probably be operated 24 hours per day and 7 days per week during the harvest period, and less intensively during the remainder of the season.

FIGURE III.2: Breakeven Analysis For a Concentrating Facility



IV ALTERNATIVE PRODUCTION PRACTICES IN ORCHARDS

Throughout all apple producing regions of Canada, the overriding production practice has been the maximization of the harvest of fresh market apples. So much has fresh market apple production influenced the industry that apples redirected through processing plants have only received by-product status. As the production of fresh apples in Canada may exceed fresh market requirements in the near future, there may be a need to consider processed (juice) apples as an integral product contributing to the viability of apple production. The following section discusses the parameters and production practices required in order to enhance the production of apples for processing and some of the problems and constraints inherent within the apple sector.

SUPPLY OF AND DEMAND FOR APPLES

One of the major considerations necessary before a concerted effort to increase the production of juice apples is undertaken is an analysis of the supply and demand consequences. The results of supply changes in both the fresh and juice markets affect the producer differently as the demand curves in each market are different.

Fresh Apple Market

As with the majority of agricultural products the demand for fresh apples is inelastic. That is to say, as the quantity supplied to a particular market in a given period increases, the price of that product decreases to such an extent that the total income derived at the new quantity is less than at the original price and quantity.

In the Canadian situation, production of fresh apples has rarely exceeded the demand for fresh apples produced in Canada. However, past crop values illustrate the inelasticity of demand (see Table IV.1). The large crop harvested in 1980 resulted in lower farm revenues than the subsequent "crop failure" year, 1981. In 1980 total farm revenue for fresh apples was $68,015 thousand when fresh apple production reached an all time high of 349,091 tonnes. The 1981 crop of 229,325 tonnes (reduced in Eastern

TABLE IV.1: Gross Farm Revenue From Fresh Market Apples

GROSS FARM REVENUES FROM FRESH MARKET APPLES

PROVINCE	1980 Production[1] (tonnes)	1980 Value ($000's)	1981 Production (tonnes)	1981 Value ($000's)	1982 Production (tonnes)	1982 Value ($000's)	1983 Production (tonnes)	1983 Value ($000's)
BRITISH COLUMBIA	155818	27972	132850	36461	138693	26606	129466	36280
ONTARIO	86796	19763	44222	21700	81498	24984	65153	22234
QUEBEC	82700	15367	27182	9274	54676	15957	45555	13376
NOVA SCOTIA	18442	3947	20118	5045	21337	2341	24328	4827
NEW BRUNSWICK	5335	966	4953	1482	4191	1046	4401	1648
CANADA	349091	68015	229325	73962	300395	70934	268903	78365

SOURCE: Statistics Canada, Fruit and Vegetable Production Cat #22003 Seasonal.

Canada because a severe winter kill) yielded a farm income of $73,962 thousand, an 8.7% increase in revenues while production declined by 34%.

The implication of inelasticity of demand is the prospect that future fresh apple revenues will be severely reduced due to the large area of newly planted orchards in Eastern Canada. Should higher yields coincide with an increase in productive areas the price implication could be disastrous. It appears that farmers would be better off limiting the amount of fresh apples sold on the market even if the juice apple price is very low.

Juice Apple Market

Over the past 10 years, the price for juice apples has fluctuated dramatically. From a high of over 9 cents a pound in Ontario in 1981 to a low of 0.38 cents per pound in B.C. in 1980 (see Table IV.2). The two major contributing factors to these large price swings are limited processing capacity and the willingness of producers to market juice apples at any price above harvesting costs.

TABLE IV.2: Farm Values for Processing Apples by Province (1978-1983)

CROP YEAR	BRITISH COLUMBIA	ONTARIO	QUEBEC	NOVA SCOTIA	CANADA
	($ per pound)				
1978	.0491	.0610	.0490	.0726	.0521
1979	.0276	.0693	.0593	.0545	.0555
1980	.0038	.0557	.0400	.0471	.0378
1981	.0196	.0917	.0714	.0726	.0606
1982	--	.0658	.0538	.0446	--
1983	--	.0673	.0599	.0623	--

Source: FRUIT AND VEGETABLE PRODUCTION, #22-003, Statistics Canada, Seasonal.

With the possible exception of B.C., the processing industry in Canada only processes apples during the fall months, immediately following harvest. While apples are available for juicing plants run at capacity but little attempt has been made to extend the processing season.

The demand for juice apples during the months of October and November is relatively inelastic until the capacity of processing plants reaches 100%. From that point on the quantity of juice apples demanded will not increase no matter how low the price. A further restriction placed on juice apple prices is the world price for apple juice concentrate. Processors will not pay a price higher than the equivalent cost of imported concentrate no matter how short the supply. Obviously, farmers would be better off not harvesting apples beyond the capacity point. However, delivering an optimal quantity to processors is restricted by two factors. Firstly, the determination of capacity is very difficult as the length of the juicing season depends on the weather, regional supply and other factors which may alter demands. Secondly, the by-product nature of juice apples coupled with the relatively unorganized producing sector has resulted in competition among farmers to sell all of their processing apples, thus reducing the price.

Should the proportion of juice apples produced be substantially increased, serious price erosion may occur. Either the juicing season must be extended through storage of apples or dramatic increases in juicing capacity must take place if anticipated increases in supply occur.

STRUCTURE AND LOCATION OF FARM OPERATIONS

In addition to market considerations, there are some structural constraints to dedicating orchards to juice apple production. Location, land prices, and the nature of fresh apple production all have some impact on where juice apple production may be most successful.

Location and Land Values

Throughout the various apple producing provinces, location has an effect on apple production. In British Columbia's Okanogan Valley undeveloped orchard acreage is scarce. Here, apples have to compete with other fruits, and the tourism industry for prime farm land. For these reasons, land prices have risen dramatically making expansion more difficult and demanding high

returns per hectare. For British Columbia, there are no other significant apple producing regions so that land prices will continue to demand higher returns.

Nova Scotia, like British Columbia, has only one apple producing region, the Annapolis-Cornwallis Valley. However, there seems to be some degree of expansion potential. Here too, demands for land may drive land values up requiring high returns per hectare. The other major producing provinces, Ontario and Quebec, have several apple producing regions. The opportunity for expansion there is much greater with a variety of locations being suitable for apple production. Nevertheless, the high cost of establishment has kept the value of producing orchards at a high level.

The past price situation, coupled with potential price erosion should juice apple production increase means that returns to juice have to be at least as high as and more likely higher than present prices given present production practices. The risk of converting operations on valuable land may not be an easy disadvantage to overcome.

A second observation is that Ontario and Quebec would seem to be the most likely regions to adopt a juice apple production strategy. The barriers to entry into apple production in these provinces are somewhat lower than British Columbia and Nova Scotia. Also, the large processing capacity already in Ontario lends itself to specialized juice apple/production and processing.

Farm Size

Traditionally,the size of apple producing farms has been relatively small. This is most likey the result of two factors. Firstly, the price and location of land brought on the need for a more intensive type of farming. Secondly, the large labour input required has resulted in smaller owner operated orchards. The smaller economic unit seems well suited for fresh apple production as it allows the operator to perform the majority of the labour throughout the year.

In the event of an increase in juice apple production, the small farm may not be the ideal economic unit. Since the major strategy behind juice apple production is reduction of labour, the farmer's labour will be under-utilized. However, the costs of expansion and/or orchard establishment in order to achieve full labour utilization may deter many farmers from converting to

juice apple production. Here again, juice apple production will have to provide superior returns before the farmer will consider that option.

PRESENT PRODUCTION PRACTICES

Several cost of production studies and data from other sources were used to estimate returns to orcharding in the various apple producing provinces. A separate model was set up for each apple producing region, each one being set up to model production on a 10 hectare apple producing operation. A life of 20 years was placed on the orchard with an equal area assumed to have been planted (and replaced) each year.

The cost of production studies carried out by Agriculture Canada for the determination of subsidy payments were used as a basis for the cost information. Material inputs were entered as cash costs whereas the labour input was split between operator and hired. The hired labour was treated as a cash cost whereas the operator labour was treated as a non-cash cost with the rate/hour being equal to the hired labour rate in each province. Machine repairs and maintenance were entered as cash costs and depretiation rates (based on useful life with no salvage value) were added to the non-cash costs.

Yields

As it was assumed that the model orchard was operated by a prudent producer, yields would be expected to be greater than average. The low yield used was taken from provincial studies or enterprise analyses. For sensitivity, a yield increase of 25% was also analyzed. Although the yields used may not coincide with the yields used in the cost of production study, the returns to management changes resulting from yield increases will be used to analyze relative impacts rather than absolute values.

Fresh Juice Apple Split

Another important factor is the percentage of the crop directed through the fresh apple market and the juice apple market. Table IV.3 outlines the past sales to each of the markets. Trends seem to indicate that 70% of the crops of British Columbia and Quebec are sold in the fresh market whereas only 40% of the crops in Ontario and Nova Scotia end up as fresh market apples.

TABLE IV.3: Apple Sales to Fresh and Juice Markets (1980-1983)

APPLE SALES TO FRESH AND JUICE MARKETS

PROVINCE	1980		1981		1982		1983		MODEL	
	Fresh tonnes	Processed tonnes	Fresh tonnes	Processed tonnes	Fresh tonnes	Processed tonnes	Fresh tonnes	Processed tonnes	Fresh tonnes	Processed tonnes
British Columbia	155818	54433	132850	69212	138693	36730	129466	65488	70%	30%
%	74%	26%	66%	34%	79%	21%	66%	34%		
Ontario	86796	84539	44222	71353	81498	77537	65153	100274	40%	60%
%	51%	49%	38%	62%	51%	49%	39%	61%		
Quebec	82700	35816	27182	18121	54676	23433	45555	15923	70%	30%
%	70%	30%	60%	40%	70%	30%	70%	30%		
Nova Scotia	18442	28710	20118	34368	21337	37721	24328	29014	40%	60%
%	39%	61%	37%	63A	36%	64%	46%	54%		

Should production dramatically increase in Quebec due to the increase in productive area, the fresh/juice split will likely decline.

In interpreting the proportions of fresh and juice apples it must be realized that production techniques in Ontario and Nova Scotia can result in a yield of more than 40% of sufficient quality to market as fresh. However, in aggregate, the "average" farm will have to reallocate some of those fresh quality apples to the juice apple market.

Prices

Determining the prices farmers will receive for their produce is extremely difficult. Two price levels were used to assess the impact of increased production. Firstly, prices of $250/tonne for fresh applies and $110/tonne for juice apples were applied. These levels are close to what has been experienced in Canada over the past year. Secondly, prices of $187.50 and $82.50/tonne were applied for fresh and juice apples respectively (25% less than the original prices). Should there be an increase in production, price levels will most likely decline.

JUICE APPLE PRODUCTION

Production of apples for the juice market is still in the exploratory phase. Much of the work done on the subject has been completed at the Agriculture Canada Smithfield Experimental Farm near Trenton Ontario. Dr. R. Miller, the Station Superintendent has completed several years of research into juice apple production and yield maximization. Because of yield changes from year to year, several years are required to test various operating procedures. Several more years of experimentation may be required before refined juice apple production techniques are available.

For the purposes of this report, the procedures being tested at the Smithfield Experimental Farm were used in defining juice apple production programs.

Production Strategies

As mentioned at the outset, Canadian apple production has been characterized by maximization of the production of fresh market apples. A

considerable amount of care is taken through the pruning and harvesting stages. Also, fertilization, pest management and scab control are all geared to producing high quality fresh market apples.

On the other hand, juice apple production, because of the market price differences, requires increased yields with less consideration given to the quality of the end product. Smaller, poorly coloured and bruised apples demand the same price as Fancy apples when sold for processing. The second component of juice apple production is labour minimization. Both pruning and harvesting should be performed in the most expedient manner. Nevertheless, should these changed management practices result in the production of some fresh market fruit, that fruit which is easily accessible, should be harvested in the traditional manner and marketed as fresh produce.

Pruning

In a series of studies at Smithfield, the effects of dormant or spring pruning have been studied against summer pruning. Though still too early to be conclusive, juice apple production seems to be better served through summer pruning since tree girth and height seemed to be greater. When producing for tonnage, tree strength is an important consideration.

According to Agriculture Canada's cost of production studies, the amount of time spent pruning mature trees varies from 24.56 hours/ha in Quebec to 66.9 hours/ha in British Columbia. Much of the time is spent pruning interior branches so that a larger percentage of interior apples can be sold on the fresh market.

When producing juice apples, the more branches left on a tree, the more apples will be available to be harvested. A mechanical pruning technique has been tried at Smithfield with promising results. A sickle bar mower with a nine food blade is mounted on a three point hitch tractor. The mower is then driven through the orchard making hedge rows. The mower can cut branches up to one inch thick and a simple guard allows the trees to be pruned in virtually the same position each year. Later a platform wagon is driven through the rows and the tops of trees are pruned with simple cuts. Only 3.5 to 5.0 hours of pruning are required per hectare, a tremendous savings in labour.

Not only is the pruning time reduced but yield is increased between 15% and 36% depending on the rootstock. A yield increase of 25% was tested in this

study. Both colour and size of apples are sacrified by mechanical pruning because of shading on the internal part of the tree and the greater concentration of branches.

The nine foot sickle bar mower costs about $4,300 and has been assumed to have a useful life of 2,000 hours, 25% less than a conventional mower. Total accumulated repairs are estimated at 125% of cost. The platform wagon used to trim tree tops is expected to cost $1,500, slightly more than an orchard wagon. Useful life is expected to be 5,000 hours with accumulated repairs equal to the original cost. This wagon would also be used during harvest.

Fertilization

In order to assist in the growth of the mechanically pruned trees, an additional 0.68 kg (1.5 lbs) of ammonium nitrate could be applied to each tree during its bearing years. More vigorous growth results but the higher nitrogen levels also contribute to poor colouring and size reduction. It appears that after a few years of extra fertilizer the trees can no longer be returned to an emphasis on production of high quality fruit for the fresh market.

Insecticides and Fungicides

Juice apples do not require the same level of pest and fungicide management as fresh market apples. However, insect infestation and scab must be controlled so that the health of the trees is maintained and there is only limited insect damage to the fruit. Also, because neighbouring farms may produce fresh market appples, it is important that these problems be properly controlled.

Minimum spray programs have been tested at Smithfield. Initially, single applications of insecticides and fungicides were made. However, some problems developed and increases in both insecticides and fungicides were required.

For the purposes of this study, it was assumed that only 70% of the present levels of insecticide and fungicide applications were required. Since a variety of products are used in the various regions, the same proportion of those products would be used.

Harvest

About one third of present costs per hectare are spent during harvest. The expense is primarly hired picking labour with handling also being a significant expense. Reduction of these costs can improve the returns per hectare dramatically.

Given the juice apple production program, about 25% of the apples would still be of sufficient quality for the fresh market. These apples would be located at the top and on the sides of the trees. At present price levels, it would be worthwhile to harvest those apples for the fresh market. The remainder of the apples will be directed to the juice market.

Various harvesting methods have been developed for the harvest of juice apples. One of the most innovative is the windrower-harvester developed by Agriculture Canada. This technology is still quite new and its cost of around $30,000 would slow its adoption as standard practice. Also, mechanical tree shaking, given the price of juice apples and small farm sizes, does not seem feasible. By delaying harvest, manual shaking of branches is only marginally more time consuming and is more cost effective.

Research into harvesting rates at Smithfield indicates that regular ladder to tree picking can be performed at the rate of 5 bushels per hour per person whereas picking from a platform along a hedgerow can be done at the rate of 8 bushels per hour per person. Ground harvest can be completed at 12.75 bushels per hour per person. Because of different rootstocks, densities and handling capabilities, harvesting time reductions used will be based on percentage increases in harvesting speed. A rate of 11 bushels per hour per person was used for the shaking, ground pick-up combination (see Table IV.4). Handling costs were based on the volume of apples produced and applied at the rates prevelant in the various regions.

Other Considerations

Although research is continuing at Smithfield, some early implications of juice apple production are becoming apparent. Firstly, the larger numbers of apples per tree requires better bud formation managament. An application of Alar and Ethrel growth regulant during the last week of June reduces apple drops during the summer months and also helps promote fruit set for the

TABLE IV.4: Harvesting Rates for Conventional and Juice Apple Production Practices

HARVEST RATE:

Ladder to Tree:	5 bushels/hour
Platform wagon to Hedgerow:	8 bushels/hour
Ground pickup:	12.75 bushels/hour
Tree Shaking/Ground Pickup:	11 bushels/hour

PRESENT PRACTICES:

85%	Ladder to tree	=	85% x 5	=	4.25
15%	Ground Pickup	=	15% x 12.75	=	1.91

Weighted Average = 6.16 bu/hour

JUICE APPLE PRACTICE:

25%	Platform to Hedgerow	=	25% x 8	=	2.0
75%	Tree Shake/Ground pickup	=	75% x 11	=	8.25

Weighted Average = 10.25 bu/hour

Harvesting costs for similar yields using juice apple procedure will be

$$\frac{6.16}{10.25} = .60 \times \text{cost of present practice harvesting.}$$

following season. Also, since there is more fruit, a greater number of bees are required to help in pollination. A 50% increase in the number of hives has been assumed.

Secondly, the additional nitrogen, increased densities, and the heavier weight of apples increases the strain on the trees. Although no optimal life for juice apple trees has been determined, it is apparent that the life is shorter than fresh market apple trees. A life of 15 years was used during the study. A summary of the changes made is shown in Table IV.5.

TABLE IV.5: Changes to Cost of Production Under Current Practices to Simulate Juice Practice

1. Pruning time, 100% owner completed.
   40 HP Tractor and Sickle mower: 4.0 hours/Ha BC; 3.0 hours/Ha. Ont; 2.5 hours/Ha Que; 3.0 hours/Ha. NS;
   40 HP Tractor and Platform wagon: 1.0 hours/Ha for all provinces.

2. Fertilizer: .68 Kg (1.5 lbs) Ammonium Nitrate is added to each bearing trees each year.

3. INSECTICIDE/FUNGICIDE: 70% of Present Levels; 70% of Hours used.

4. JUICE/FRESH SPLIT: 75% of tonnage harvested are juice apples; 25% are fresh market apples.

5. Pollenation; 50% increase in the number of bees required.

6. Alar 2.25 Kg/Ha non bearing trees; 1.1 Kg/Ha bearing trees
   Ethrel 2.00/Ha non-bearing trees; 1.5L/Ha bearing trees

7. Machine hour changes:
   - Apple sprayer used 70% of previous, plus growth regulator application
   - Bin handling 25% increase
   - Tractors used 10% less after planting year
   - Pruning equipment used 1 hour/year with platform wagon
   - Platform wagon used for the fresh fruit harvest
   - Mechanical ladders no longer used.

SUMMARY AND CONCLUSIONS

The cost of production models provide some direction in answering the question of whether there should be an emphasis on producing more juice apples. However, because of the estimates used for yield, price and the fresh/juice market split, the results of the model cannot be used to assess the profitability of apple production across provinces. The relevant comparisons are those which compare the present systems of juice apple production systems within the various provinces. The relative returns within each province should be used in drawing conclusions.

The major differentiating factor will be Return to Management. Return to Management is calculated by subtracting cash costs, interest on operating capital, and non-cash costs from revenue. Breakeven levels for yield and blended price to achieve a $20,000 total farm income, and to cover cash costs only, were also calculated. Examples of the spreadsheet models can be obtained from Agriculture Canada on request while a summary of the results is presented in Tables IV.6 and IV.7. Four separate analyses have been completed for each of the present and juice apple systems within each province. Figure IV.1 illustrates how the sensitivity analysis was carried out.

Table IV.6 illustrates the Return to Management for each of the provinces under present and juicing practices. For both Ontario and Nova Scotia, producers would be marginally better off producing apples using the juice apple system. Conversely, British Columbia and Quebec would be better off maintaining their present practices. It is important to realize that these results only hold true if, by changing production practices, there is no detrimental effect on prices. On an individual farm basis this would be true but in aggregate, supply increases must be considered.

The major underlying reason for the feasibility of juicing systems in Ontario and Nova Scotia is the proportionally smaller fresh apple market. With only 40% of production being directed through the fresh apple market, reducing the split from 40%/60% to 25%/75% while increasing the yield only results in a relatively small reduction in the amount of apples supplied to the fresh market. Since the cost of producing fresh apples is higher than producing juice apples, not producing more fresh apples than can be marketed makes a lot sense. For Ontario and Nova Scotia, the juice apple practices, since fresh apples are still produced, are not just a strategy for producing juice apples but may be a better strategy for producing apples in general. However, should the practice become popular on a widespread basis, markets must be found for the increased supply of juicing apples.

TABLE IV.6: Returns to Management Under Present and Juice Apple Production Practices

PRESENT PRACTICES VS JUICE APPLE PRACTICES
COMPARISON OF RETURNS TO MANAGEMENT

	BRITISH COLUMBIA		ONTARIO		QUEBEC		NOVA SCOTIA	
	Present	Juice	Present	Juice	Present	Juice	Present	Juice
YIELD - Provincial Studies Price - 250/110	17824	11483	6032	8161	5972	3630	(2612)	(1037)
YIELD - 25% Increase Price - 250/110	31386	21826	13565	15472	14681	10209	2760	4177
YIELD - 25% Increase Price - 187.50/82.50 (25% less)	14434	8898	4149	6333	3670	1985	(3955)	(2340)
YIELD - Provincial Studies Price - 187.50/82.50 (25% less)	4263	1141	(1500)	851	(2936)	(2949)	(7984)	(6251)

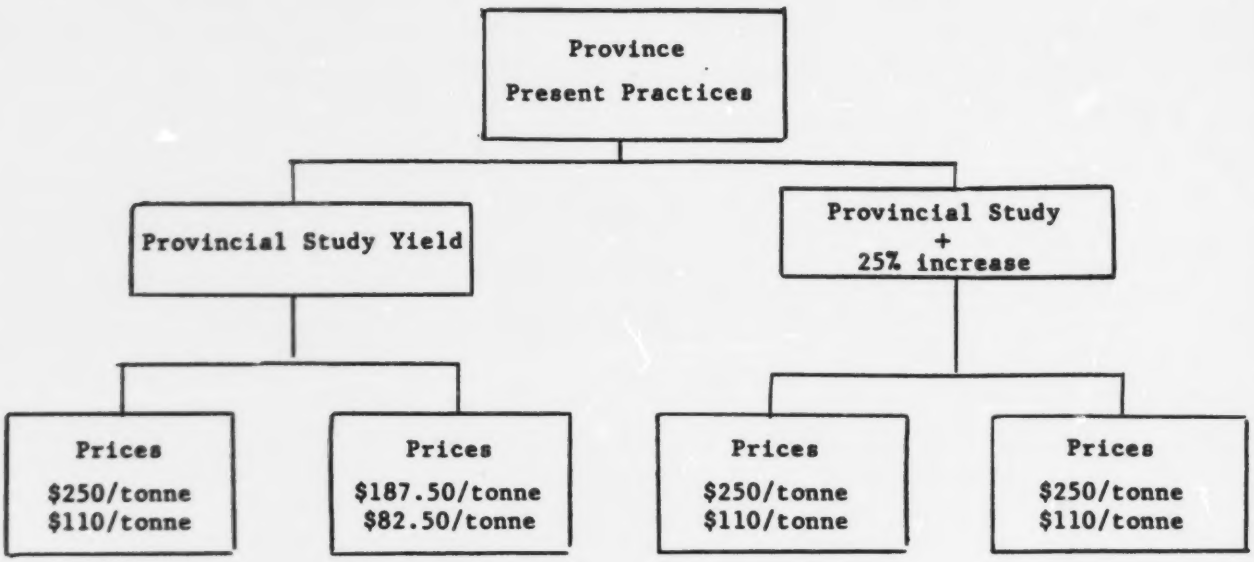
TABLE IV.7: Breakeven Levels Under Present and Juice Apple Production Practices

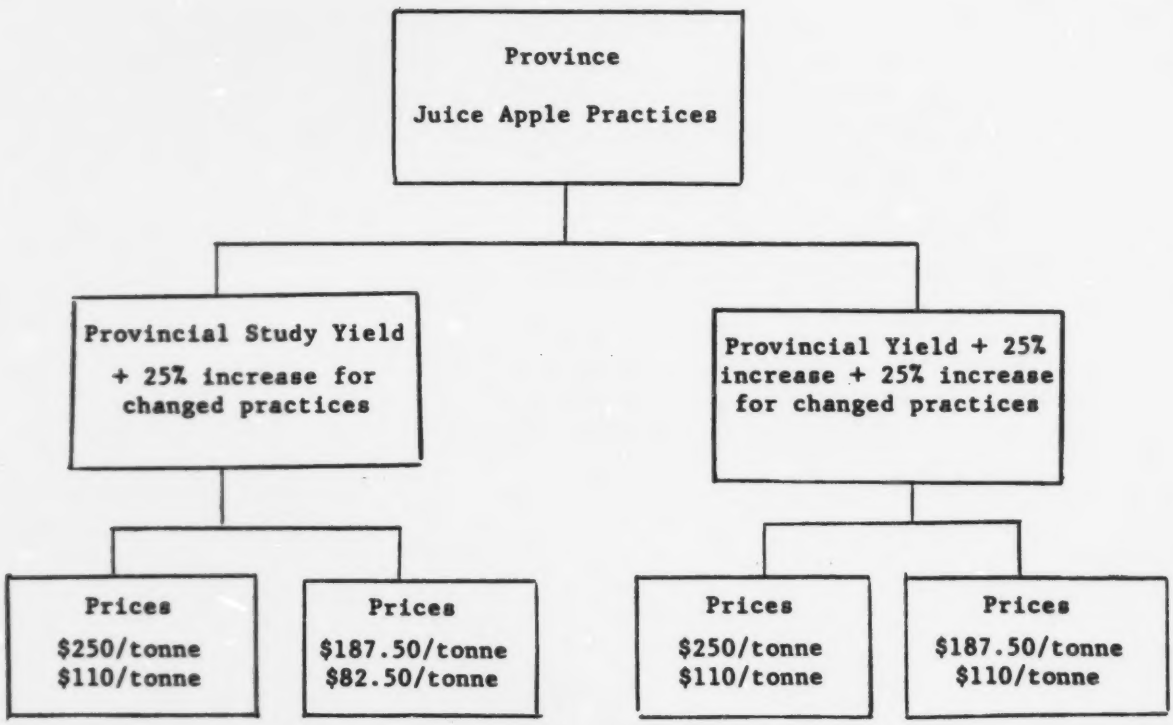
PRESENT PRACTICES VS JUICE APPLE PRACTICES
BREAKEVEN LEVELS UNDER VARIOUS SCENARIOS

	BRITISH COLUMBIA		ONTARIO		QUEBEC		NOVA SCOTIA	
	Present	Juice	Present	Juice	Present	Juice	Present	Juice
Fresh/Juice Market Sales	70%/30%	25%/75%	40%/60%	25%/75%	70%/30%	25%/75%	40%/60%	25%/75%
Yields/Provincial Studies (T/Ha)	26.08	28.53	18.15	20.17	16.94	18.15	12.95	14.38
Yield 25% Increase (T/Ha)	32.60	35.66	22.69	25.21	21.18	22.69	16.19	17.98
Blended Price 250/110 ($/T)	208.50	145.00	166.00	145.00	208.00	145.00	166.00	145.00
Blended Price 182.50/82.50 ($/T)	156.00	108.75	124.50	108.75	156.00	108.75	124.50	108.75
Yield Provincial Studies								
$20000 BE Price ($/T)	199.30	164.92	236.35	198.57	285.01	230.01	330.63	285.71
Cash Cost BE Price ($/T)	103.75	80.67	111.44	87.15	147.58	105.88	148.00	131.58
Yield 25% Increase								
$20000 BE Price ($/T)	159.44	131.93	189.08	158.86	228.01	184.01	264.51	228.51
Cash Cost BE Price ($/T)	183.00	64.54	89.16	70.36	118.07	84.70	126.40	105.26
Price - 250/110								
$2000 BE Yield (T/Ha)	24.99	32.45	25.84	27.62	23.21	28.79	25.78	28.34
Cash Cost BE Yield (T/Ha)	13.01	15.87	12.19	12.23	12.02	13.25	12.32	13.05
Price 187.50/82.50								
$2000 BE Yield (T/Ha)	33.32	43.26	34.46	36.82	30.95	38.39	34.38	37.78
Cash Cost BE Yield (T/Ha)	17.34	21.16	16.25	16.31	16.03	17.67	16.43	

NOTE: $20000 total farm income = Returns to Management + Operator labour

FIGURE IV.1: Structure of Sensitivity Analysis





Conversely, using the same logic, producing provinces with large markets for fresh apples are not better off by sacrificing those high priced sales for lower priced juice apple sales. British Columbia, with the best access to Western Canada and export markets, would be better off producing apples for the fresh market.

Presently, Quebec also markets a high proportion of its production in the fresh market. As more area in Quebec becomes productive, the fresh/juice market split may decline to the extent that promotion of techniques for juice production may become a viable alternative.

Since the system of producing a higher proportion of juice apples while maintaining a degree of profitability exists, promoting the system may be in the industry's best interest given the increasing supply of fresh market apples. However, in doing so, the industry must consider two major factors: local parity between producers using the present system and the juice apple system, and the world price situation for apple juice concentrate.

If a program to promote the production of juice apples is instituted, not only must the returns be equal to the present system, but those returns must remain equal in the long run. Should juice apple prices decline because of increased production, returns to those operating under the juice apple system will decline at a much greater rate than those producing under the present system since the fresh apple market may not be seriously affected.

The second consideration is the world price for apple juice concentrate. Once a producer locks himself into a juice production system, declines in the world price may place downward pressure on local juice apple prices even if there are sufficient markets for those juice apples.

Again, the producer may be forced to take a lower return than fresh market producers due to forces beyond his control.

The opportunity exists to increase the importance of juice apple production in Ontario, Nova Scotia, and possibly Quebec in the future. However, overcoming the risk of future price fluctuations must be given consideration before juice apple production techniques are recommended on a wide scale.

V SITUATION AND OUTLOOK

Imports of concentrated apple juice have increased from 2.3 kilotonnes in 1976 to 15.1 kilotonnes in 1984. Such a rapid increase raises questions about the impact of imported concentrate on Canada's apple production and processing sectors. In order to evaluate the impact of these imports, and to explore possible consequences if present trends continue; imports since 1970, the relation between consumption of fresh and reconstituted juices, and factors influencing demand for apple juices are reviewed. Demand projections for 1985, 1990, and 2000 are also presented.

Concentrated apple juice is a commodity with a number of characteristics that facilitate international trade. It has a relatively high value to weight ratio, requires no special shipping or storage facilities (i.e. refrigeration is not necessary), and it keeps well without the addition of preservatives. The most common containers used in international trade are steel drums with a capacity of 55 U.S. gallons. Bulk handling can be utilized where volumes handled justify the installation of appropriate facilities.

Both juices and concentrates vary considerably as to sugar content, acid content, colour, and a number of other characteristics. Although all of these characteristics are considered by concentrate buyers, the fundamental characteristic is the relation between solids and water and is expressed as Brix (percent sugar in the concentrate). Concentrates traded internationally are usually between 70 and 72 Brix (70 to 72 percent sugar). Apple juice from fresh apples varies from 11 to 13 Brix and reconstituted apple juice in Canada must have a minimum Brix of 10.5. Reconstituted apple juice is chemically indistinguishable from "pure" juice and by carefully selecting concentrates on the basis of a number of physical characteristics can be made indistinguishable from "pure" juice with regard to colour, taste, aroma, and other physical characteristics. In the discussion that follows it is assumed that fresh apples yield 70% by weight of 11.5 Brix apple juice and that 70 Brix imported apple juice concentrate is diluted with 6.667 parts of water (by weight) to yield 10.5 Brix reconstituted juice. Throughout the discussion small imports and exports of frozen apple juice concentrate (45 Brix) are ignored.

TABLE V.1: Imports of Apple Juice Concentrates (not frozen) by Country of Origin, 1970 to 1984 (kg)

COUNTRY OF ORIGIN	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
UNITED KINGDOM	102,892	57,907	185,454	101,728	102,562	91,042	0	0	0	54,989	0	87,149	0	1,662	1,074
AUSTRIA	728,897	25,407	24,564	0	80,804	27,250	0	0	0	0	18,900	322,781	875,820	4,188,208	5,529,411
BELGIUM LUXEM	0	0	0	0	0	0	0	0	0	0	0	24,875	237,436	0	0
FRANCE	5,501	458,803	58,184	30,830	487,498	158,428	0	0	0	99,230	202,319	322,830	0	38,150	0
WEST GERMANY	18,118	39,206	13,918	35,202	217,588	39,997	0	0	0	118,384	133,377	737,691	1,828,432	1,088,750	1,488,852
ITALY	0	0	0	0	0	0	0	0	0	0	39,525	1,898	0	0	0
NETHERLANDS	14,913	11,375	20,534	20,948	22,098	18,905	0	0	185,482	110,838	33,553	111,179	378,289	248,088	508,833
PORTUGAL	0	0	0	0	0	0	0	0	0	0	0	0	0	21,738	85,489
SPAIN	8,898	5,595	7,853	22,148	88,278	31,853	0	0	0	205,151	0	55,978	234,455	180,509	324,598
SWEDEN	0	0	0	0	0	0	0	0	0	8,488	0	0	0	0	0
SWITZERLAND	1,183,971	1,489,794	0	0	851	0	0	0	0	0	471,982	138,914	148,877	211,692	434,858
BULGARIA	247,622	15,307	428,853	0	528,179	97,498	0	0	0	0	0	0	0	0	0
HUNGARY	782,815	282,743	119,999	2,548	199,359	0	0	0	0	310,858	952,888	1,119,237	721,138	1,312,588	957,838
POLAND	0	98,335	100,182	78,978	0	0	0	0	0	0	0	0	0	67,711	248,857
YUGOSLAVIA	253	8,588	1,427	488	0	0	0	258,948	381,299	107,382	99,979	179,998	329,832	582,798	335,124
ISRAEL	28,482	0	0	0	0	588,843	0	0	0	23,035	49,858	487,127	178,528	0	19,512
TURKEY	0	0	0	0	28,598	0	0	0	0	788,282	395,889	0	0	0	94,779
SOUTH AFRICA	0	0	395,221	144,388	158,248	718,284	758,282	994,233	1,358,212	1,774,488	1,775,828	1,758,888	2,393,884	1,834,998	982,884
SINGAPORE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8,281
AUSTRALIA	0	0	0	0	0	0	0	0	0	0	0	0	192,838	0	0
NEW ZEALAND	0	0	0	73,548	181,288	458,415	0	0	228,398	81,711	0	341,743	1,321,838	322,193	489,881
ARGENTINA	19,393	241,288	888,442	977,385	589,728	1,833,444	828,347	1,233,747	2,388,871	2,387,329	374,485	2,559,884	1,128,522	2,237,198	1,583,878
BRAZIL	0	0	0	1,958	0	3,955	0	0	0	0	0	482,524	0	0	0
CHILE	0	0	0	0	0	0	0	0	0	958,785	841,598	228,183	1,788,981	818,387	788,888
PERU	0	0	0	0	0	0	0	0	0	0	0	34,918	0	0	34,495
TRINIDAD TOBAGO	0	0	0	0	0	0	0	0	0	0	0	0	24,548	0	0
MEXICO	0	0	0	0	0	0	0	0	0	88,889	0	0	0	0	0
U.S.A.	488,529	324,878	288,818	598,947	442,428	298,222	383,185	142,887	785,854	1,153,788	975,185	1,895,783	1,774,918	1,278,289	1,381,918
ORIGIN UNSPECIFIED	0	0	0	0	0	0	514,358	853,488	718,888	0	0	0	0	0	0
TOTAL	3,817,845	3,828,415	2,382,448	2,888,971	3,843,192	4,333,127	2,288,884	3,478,881	5,882,794	8,159,128	8,383,588	18,818,115	13,287,478	13,388,793	15,115,524
KILOTONNES RECONSTITUTED	24.118	28.178	15.358	13.913	28.288	28.888	15.887	23.187	39.382	54.394	42.423	88.794	88.458	89.285	188.778

SOURCE: Trade of Canada

CONCENTRATED APPLE JUICE IMPORTS, 1970 to 1984

Imports of apple juice concentrates (not frozen) from 1970 to 1984 are summarized in Table V.1. Trade of Canada publications contain country detail for imports of apple juice concentrates from 1976 to 1984. The data presented in Table V.1 for the years 1970 to 1975 are estimates based on imports under a more general category, fruit juice concentrates (not frozen) N.E.S. An analysis of the relationship between imports of apple juice concentrates and the more general category of fruit juice concentrates from which apple juice concentrates were separated starting in 1976 revealed reasonably stable relationships between the two classifications. Mexico, for instance, was the origin of substantial quantities of other fruit juice concentrates between 1976 and 1983 but not of apple juice concentrate. Imports of fruit juice concentrates from Mexico from 1970 to 1975 were therefore not considered to include any apple juice concentrates in the preparation of the estimates. A similar consideration of each of the exporting countries was made to arrive at the estimates for 1970 to 1975 contained in Table V.1. Imports of juice concentrates from Bulgaria between 1970 and 1975 were considered apple juice concentrate.

The trade data is considered to reflect the actual country of origin except in the case of the United Kingdom and the United States. Imports from the U.K. are thought to be of European or African origin, while those from the U.S. are thought to be mainly of South American origin.

Using 1976 to 1983 as the base period Argentina was the largest single supplier of apple juice concentrates with a 21% share of the Canadian market. South Africa had the second largest share at 19%. The United States had a 12% share and Austria, West Germany, Hungary, and Chile had shares between 5 and 10 %. The important sources of supply can therefore be grouped into four regions: South America (Argentina and Chile), The United States, Central and Eastern Europe (West Germany, Austria, and Hungary), and South Africa.

A summary of imports, exports, and net trade is presented in Table V.2. The juice equivalent of net concentrate imports increased from 12.5 to 79.1 kilotonnes over the 1970 to 1983 period. The fresh apple equivalent of 1983 net imports is 113 kilotonnes, an amount equal to one quarter of the 485 kilotonnes of apples produced in Canada in 1983.

TABLE V.2: Imports and Exports of Apple Juice Concentrates (not frozen), 1970 to 1983 (Metric Tons)

YEAR	IMPORTS (A)	EXPORTS			NET IMPORTS (E)=(A-D)	JUICE EQUIVALENT	
		DOMESTIC (B)	RE-EXPORTS (C)	TOTAL (D)=(B+C)		NET IMPORTS (E*6.667)	IM - RE-EXPORTS ((A-C)*6.667)
1970	3617.65	199.16	1541.12	1740.28	1877.37	12516	13844
1971	3026.42	602.38	660.62	1263.00	1763.42	11756	15772
1972	2302.44	73.26	33.22	106.48	2195.96	14640	15128
1973	2086.97	464.04	124.59	588.63	1498.35	9989	13083
1974	3043.19	140.14	14.09	154.23	2888.96	19260	20194
1975	4333.13	326.70	29.92	356.62	3976.51	26510	28688
1976	2260.06	308.67	152.87	461.54	1798.52	11990	14048
1977	3475.08	205.45	14.97	220.42	3254.66	21698	23067
1978	5902.79	15.03	39.17	54.20	5848.60	38991	39091
1979	8159.12	231.76	63.90	295.66	7863.46	52423	53968
1980	6363.51	582.38	76.78	659.16	5704.35	38029	41912
1981	10019.10	1619.41	251.14	1870.55	8148.55	54324	65120
1982	13267.50	1270.53	363.01	1633.54	11634.00	77560	86030
1983	13380.80	1096.10	414.83	1510.93	11869.90	79133	86440

SOURCE: Columns A (1976-83), B, and C: Trade of Canada

DISAPPEARANCE OF "PURE" and "RECONSTITUTED" APPLE JUICES IN CANADA

Estimates of domestic disappearance of "pure" and "reconstituted" apple juices presented in Table V.3 and in Figure V.1 clarify the relative magnitudes of consumption of the two kinds of apple juice and trends in consumption. The estimates are based on the assumption that reconstituted juices are not exported and that they are not stored. This is necessary because no data on production of concentrates in Canada are available and disposition tables cannot be drawn up. The assumption that production of reconstituted juice is equal to domestic disappearance is probably reasonably realistic given that it is easier to store or transport concentrate than it is to store or transport reconstituted juice.

For the three years 1970 to 1972 disappearance of pure juice averaged 2.5 kg per capita while disappearance of reconstituted juice averaged 0.28 kg per capita. During that period reconstituted juice represented approximately 10% of all apple juice disappearance. For the three years 1980 to 1982 disappearance of pure juice averaged 4.36 kg per capita while disappearance of reconstituted juice averaged 1.69 kg per capita. Reconstituted juice's share of total juice consumption had risen to about 28%. During the ten years between these two periods substantial increases in the consumption of both pure and reconstituted juices took place. Pure juice consumption almost doubled while reconstituted juice consumption increased sixfold.

FIGURE V.1: Per Capita Disappearance of Apple Juice in Canada, 1970-1981

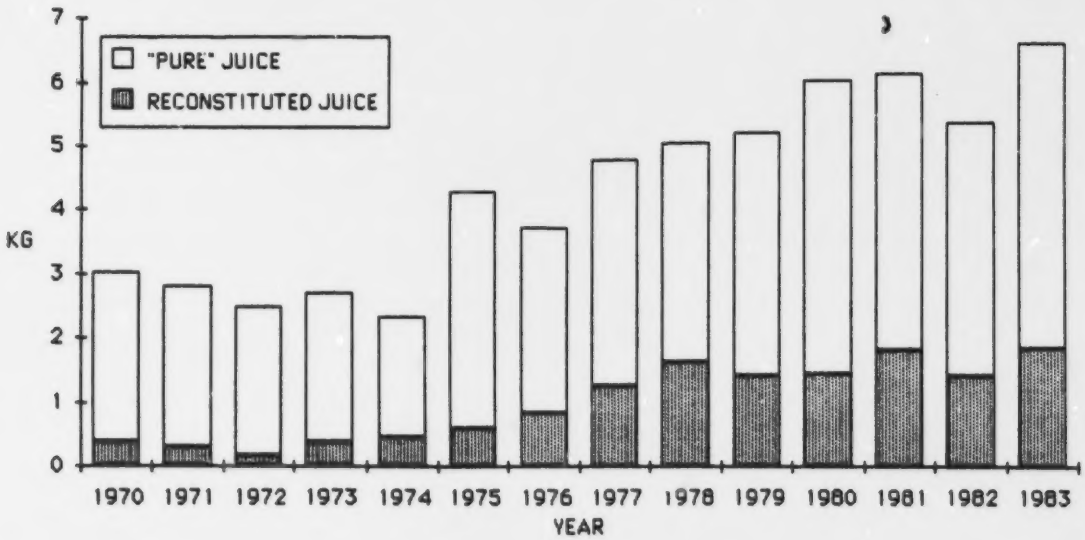


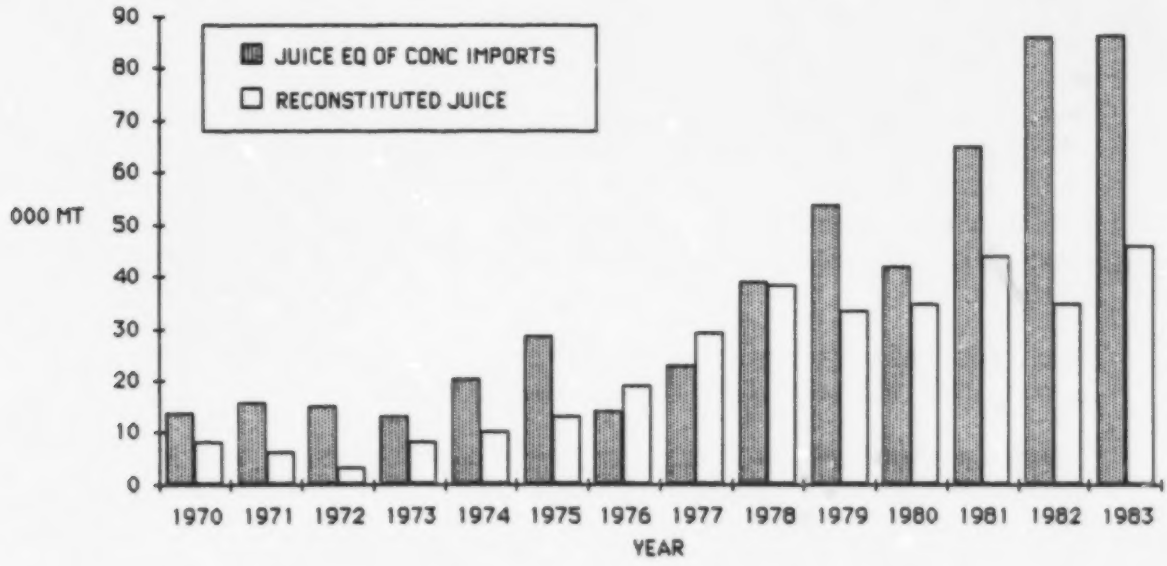
TABLE V.3:- Supply and Disposition of Pure and Reconstituted Apple Juices in Canada, 1970 to 1983

YEAR	PRODUCTION	BEGINNING STOCK	ENDING STOCK	EXPORTS	----- TOTAL DISAPPEARANCE -----				--- PER CAPITA DISAPPEARANCE ---		
					"PURE"	RECON	PURE+RECON	POPULATION	"PURE"	RECON	PURE+RECON
	000 MT	000 MT	000 MT	000 MT	000 MT	000 MT	000 MT	MILLION	KG	KG	KG
1970	65.14	30.24	35.90	2.96	56.52	8.05	64.57	21.30	2.65	0.38	3.03
1971	53.17	35.90	30.04	4.69	54.34	6.29	60.63	21.57	2.52	0.29	2.81
1972	58.87	30.04	35.29	2.59	51.03	3.39	54.42	21.80	2.34	0.16	2.50
1973	42.46	35.29	21.27	5.13	51.35	8.32	59.67	22.04	2.33	0.38	2.71
1974	63.59	21.27	41.19	2.14	41.53	10.22	51.75	22.36	1.86	0.46	2.31
1975	77.32	41.19	31.46	2.97	84.08	13.11	97.18	22.70	3.70	0.58	4.28
1976	74.24	31.46	36.74	2.68	66.28	19.04	85.32	22.99	2.88	0.83	3.71
1977	87.22	36.74	37.23	4.32	82.41	29.08	111.49	23.27	3.54	1.25	4.79
1978	92.69	37.23	46.17	3.41	80.34	38.32	118.66	23.52	3.42	1.63	5.05
1979	100.60	46.17	52.38	4.12	90.27	33.49	123.76	23.75	3.80	1.41	5.21
1980	124.89	52.38	61.66	5.07	110.54	34.77	145.31	24.04	4.60	1.45	6.04
1981	115.33	61.66	58.54	12.47	105.98	44.06	150.05	24.37	4.35	1.81	6.16
1982	115.01	58.54	66.76	9.41	97.38	34.89	132.27	24.63	3.95	1.42	5.37
1983	135.50	66.76	74.50	8.56	119.20	46.01	165.21	24.89	4.79	1.85	6.64

SOURCE: Statistics Canada Catalogue 32-230 Apparent Per Capita Food Consumption in Canada and Catalogue 32-023, Fruit and Vegetable Preservation.

Although the approach to deriving estimates in Table V.3 was considered the best because it is consistent with Statistics Canada estimates of domestic disappearance, an approach based on the reconstituted equivalent of concentrate imports yields sufficiently different results to require comment. Once again the lack of data on concentrate production in Canada results in an underestimation of concentrate available for reconstituting in Canada. If domestic exports of concentrate are considered to be produced in Canada then the best available estimate of concentrate available for reconstituting would be imports net of re-exports. This approach was taken in deriving the juice equivalent of concentrate available for reconstituting in Table V.2. The discrepancy between Statistics Canada data on production of reconstituted juice, and the juice equivalent of concentrate is shown in Figure V.2. The largest discrepancies between the two estimates appear in 1982 and 1983.

FIGURE V.2: Comparison of Reconstituted Juice Production and Juice Equivalent of Concentrate Imports



FACTORS INFLUENCING DEMAND FOR APPLE JUICE

Although a thorough econometric study of the demand for apple juice is not a part of this study, a number of inferences can be drawn from the results of previous studies and from an examination of price and consumption data.

A study of milk consumption by Lu and Marshall for the Ontario Milk Marketing Board found that orange juice was an important substitute for milk. A later study of milk consumption in several Canadian provinces by Deloitte Haskins + Sells for the Dairy Bureau of Canada found that apple juice was an important substitute for milk.

Figure V.3 shows movements in the consumer price indexes for milk, orange juice and apple juice. Two major variances between prices of these products are evident: an increase in orange juice prices in 1963 to 1965 relative to prices of the other two beverages, and an increase in milk prices relative to the prices of the other two beverages in 1975. The impact of the change in relative prices in 1975 can be seen in Figures V.4 and V.5. The consumption of both apple and orange juices increased substantially in 1975 while the consumption of milk declined. The only clear effect of higher orange juice prices in 1963 to 1965 was a decline in orange juice consumption.

These observations lead to a logical grouping of milk, orange juice and apple juice as cold "health" beverages consumed mainly at home. Orange juice has the additional characteristic (handicap perhaps) of being considered a "breakfast" drink. Such a grouping separates these from other major beverage groupings such as the "hot" beverages (tea and coffee) and the alcoholic beverages (wine, beer, and spirits). The remaining major beverage, soft drinks, differs from milk, orange juice and apple juice in the "health" aspect and in the greater tentency for soft drinks to be consumed away from the home.

Apple juice has advantages as an all-day substitute for milk in the home and as a health alternative to soft drinks away from home.

Among the important beverages a number of comparisons and contrasts are evident. They can be grouped into minor (Figure V.4, under 15 litres per capita) and major beverages (Figure V.5, over 60 litres per capita). The minor beverages include wine, orange juice, apple juice, and tomato juice. The major beverages include milk, beer and soft drinks. Per capita consumption of some of the beverages shows a strong upward trend. These include orange juice, apple juice, and wine. Others show weaker trends (milk, tomato juice, and soft drinks) or even declining consumption (beer).

FIGURE V.3: CONSUMER PRICE INDICES FOR APPLE JUICE, MILK, AND ORANGE JUICE

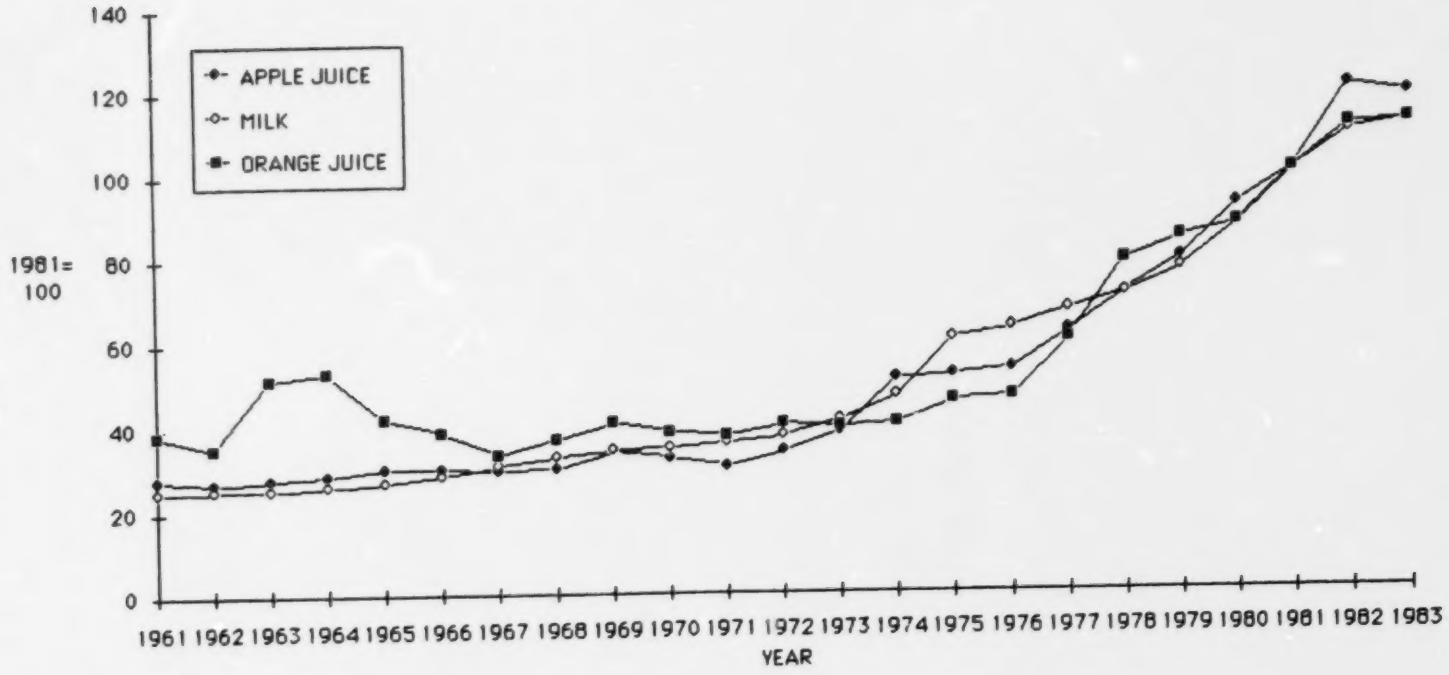


FIGURE V.4: PER CAPITA DISAPPEARANCE OF ORANGE, APPLE, AND TOMATO JUICES (KG) AND WINE (LITRES), CANADA, 1970 TO 1983

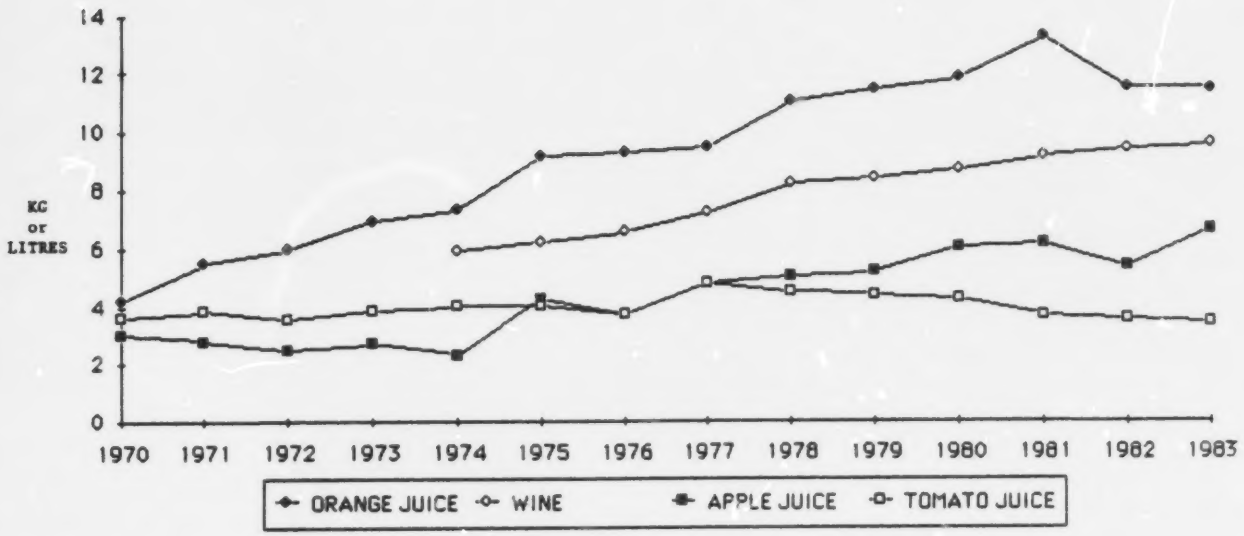
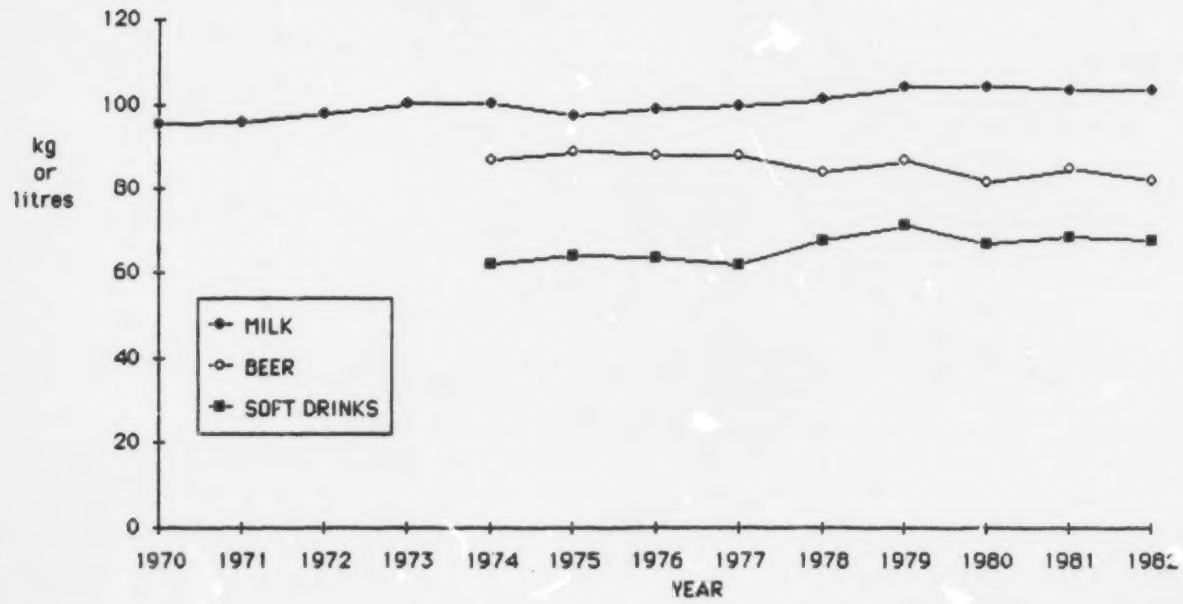


FIGURE V.5: PER CAPITA DISAPPEARANCE OF MILK, BEER & LIKE PRODUCTS, AND SOFT DRINKS (LITRES) IN CANADA, 1970 TO 1982



Reasons for the strong performance of wine, orange juice, and apple juice in relation to the other beverages remain a matter of conjecture. The two most often put forward are increasing per capita incomes and changes in consumer tastes and preferences. The case for changing tastes influencing orange and apple juice consumption is most often related to an apparent increase in health consciousness.

Only limited information on price and income elasticities for apple juice is available. Hassan and Johnson [7] estimated elasticities for "Canned Fruit", a group of commodities which includes canned apple juice and frozen orange juice. George and King [12] estimated demand elasticities for a group of commodities called "Other (non-alcoholic) Beverages" which included beverages other than milk and coffee. Elasticities reported in these two studies are shown in Table V.4. The implication of these estimates is that apple juice consumption is only moderately responsive to changes in prices and incomes. For example, the Hassan and Johnson estimates imply that (other things being equal) a 10% increase in retail price will cause a 3.2% decrease in consumption and that a 10% increase in income will cause a 1.1% increase in consumption. In comparison, several meat products and cheese have price elasticities between -.85 and -2.0 and income elasticities over 0.5.

TABLE V.4: Price and Income Elasticity Estimates

Study	Commodity Group	Elasticity	
		Direct Price	Income
Hassan and Johnson	Canned Fruit	-.32	.11
George and King	Other Beverages	-.44	.23

Although available price and quantity data does not yield statistically significant results, it reveals certain cases where reduced quantities are linked to higher prices, and vice versa. Figure V.6 shows kilotonnes of apples used in processing in Canada and an index of real (1981) prices received by Ontario farmers for processing apples. Ontario prices were used because aggregate Canadian prices are not available for 1982 and 1983. Interesting features are the strong prices and corresponding low marketings

FIGURE V.6: Processing Use of Apples and Price Received for Processing Apples

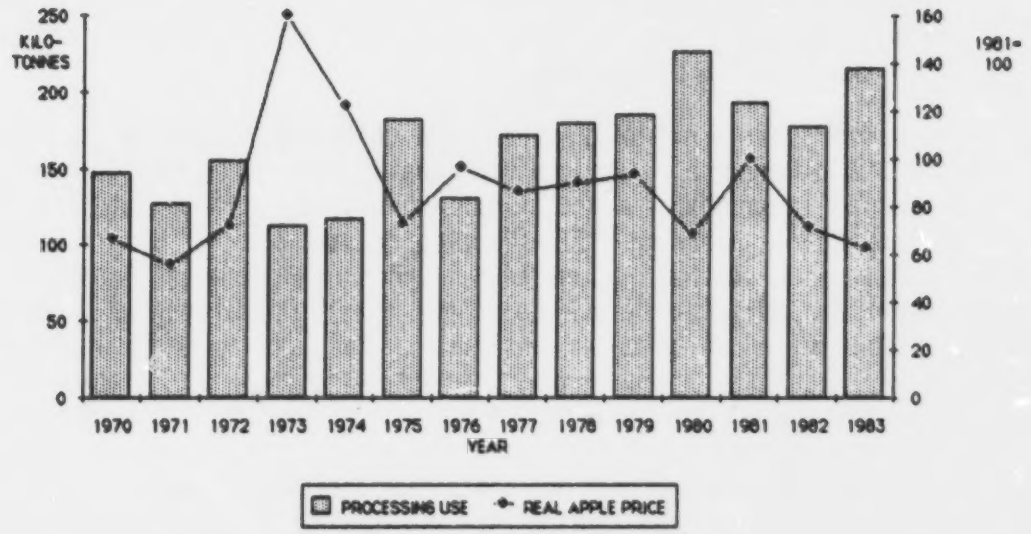
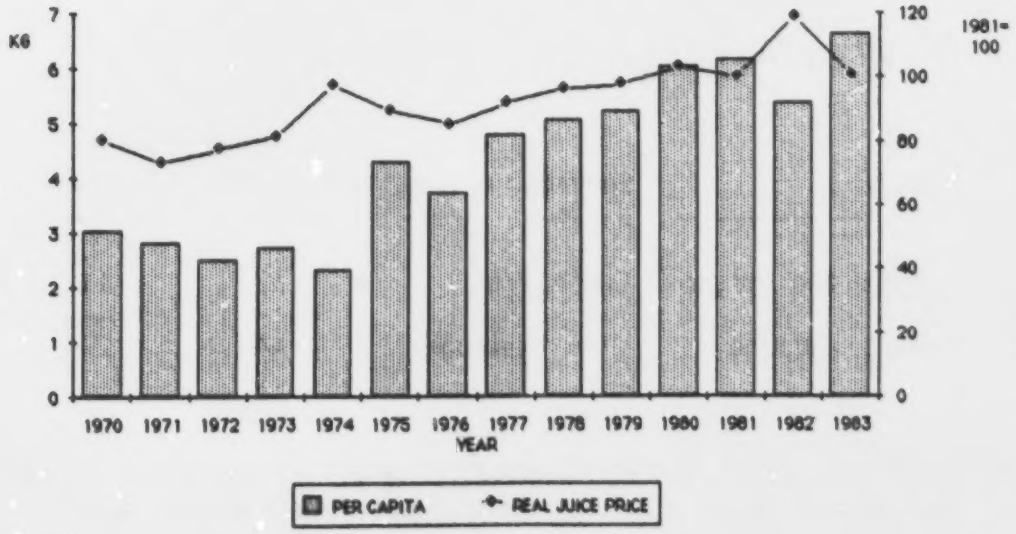


FIGURE V.7: Apple Juice Consumption and Retail Prices



In 1973 and 1974, and depressed prices and heavy marketings in 1980. Comparison of farm prices in Figure V.6 with retail prices in Figure V.7 also suggests that farm prices of processing apples are more volatile than retail juice prices.

Figure V.7 shows per capita consumption of apple juice in kilograms and the deflated consumer price index for canned apple juice. Once again, there is not a statistically significant relationship between the two variables but some interesting observations can be made. A high price in 1974 corresponds with lower than usual consumption. In 1975 consumption rebounded sharply despite a moderate decline in price. As has already been noted the sharp increase in apple juice consumption in 1975 is probably linked to the sharp increase in milk prices in the same year. A high price in 1982 corresponds with a fall in consumption resulting from reduced marketings subsequent to frost damage in 1981.

APPLE JUICE CONSUMPTION: PROJECTIONS TO THE YEAR 2000

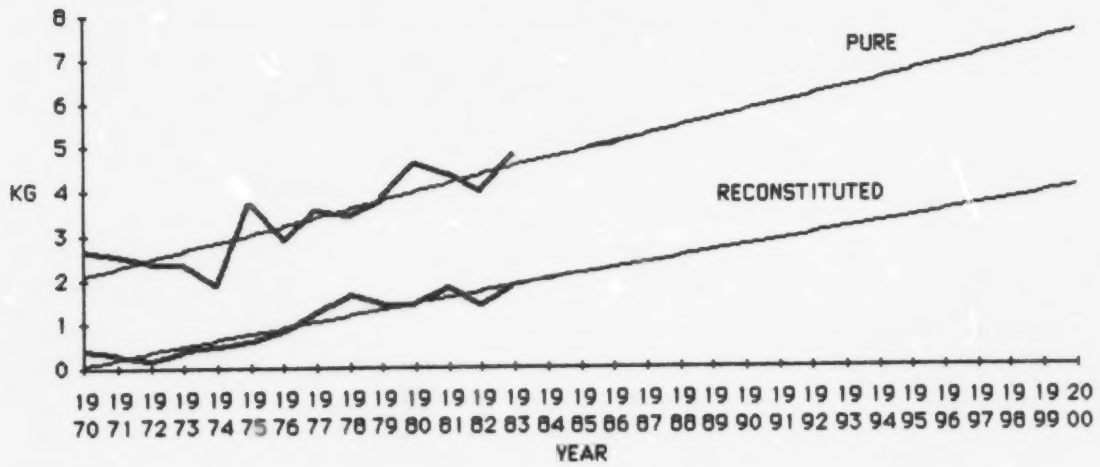
Consumption projections are a risky affair at the best of times because a number of largely unpredictable factors have an influence on consumption: prices relative to competitive products, disposable incomes, and consumer preferences to name a few of the most important. In spite of these limitations projections are useful for drawing out the implications of current trends and for identifying potential opportunities or problems. The projections presented here are meant not to imply that present trends are expected to continue indefinitely, but to show the implications should they continue. Actual evolution of the market over the next few years will be affected by the supply of juice from the Canadian production and processing sector, the situation in world concentrate markets, and other developments on the demand side as outlined above.

Table V.5: Projected Total and Per Capita Disappearance of "Pure" and "Reconstituted" Apple Juice in Canada, 1985, 1990, and 2000

	Kilotonnes			KG per Capita		
Year	Pure	Recon-stituted	Total	Pure	Recon-stituted	Total
1985	125.24	54.00	179.24	4.94	2.13	7.07
1990	153.81	73.21	227.02	5.82	2.77	8.59
2000	210.83	112.07	322.90	7.60	4.04	11.64

The projections presented in Table V.5 and in Figure V.8 represent the extrapolation of linear trends derived from per capita consumption in 1970 to 1983. They imply that from the 1981-83 base period consumption of pure juice will almost double by the year 2000 while consumption of reconstituted juice would more than double. The share of reconstituted juice would increase from 28 to 35 percent in the same period.

FIGURE V.8: Per Capita Disappearance of Pure and Reconstituted Apple Juices in Canada, 1970-1983 with projections to 2000



Total disappearance of pure juice would increase by approximately 100 kilotonnes. At 70% juice yield this would represent about 143 kilotonnes of apples. At a yield of 20 tonnes per hectare this would in turn represent production from an additional five thousand hectares.

The long term outlook then, provides opportunity for expansion of domestic production but with some erosion of pure juice's share of the total apple juice market. The rapid increase in market share experienced by reconstituted juice in 1982, 1983 and 1984, although alarming to a degree, is probably a temporary situation due to lower than usual domestic production. As the effects of the 1981 frost damage are overcome pure juice should be able to recover its position in the market.

VI FOUR BASIC STRATEGIES

In this section four basic strategies for supplying the market for apple juice are examined. Although a more complete analysis of processing, packaging, and storage costs is required before any definitive conclusions can be reached, the issues can nevertheless be clearly identified.

The first strategy would involve storing raw apples at harvest and operating a juicing and packaging facility throughout the storage season. This could involve either the grading of apples at harvest and storage of fresh market and juicing apples separately, or the storage of orchard run apples to be graded as they come out of storage. The carrying charges would consist of storage costs for raw apples and the cost of financing raw apple inventory.

The second strategy would involve juicing apples at harvest and storing the single strength juice in bulk. Bulk storage of juice has proven feasible if oxygen can be excluded from the bulk container by injection of an inert gas. The carrying charges would consist of the cost of bulk storage and the financing of juice inventory.

The third strategy would involve the manufacture of concentrated juice at harvest, storage of the concentrate, and reconstitution and packaging over an extended period. The carrying charges would consist of the cost of storing concentrate and the cost of financing concentrate inventory. The unit cost of concentrating must reflect a higher fixed cost component for operation only during the harvest season.

The fourth strategy involves juicing and packaging the product during the harvest season and storage of the juice in retail packages. All manufacturing costs are incurred during the harvest season so the carrying charges would reflect the cost of financing finished product and the cost of storing retail packaged product.

Several key variables must be considered carefully in weighing the relative merits of each of these approaches. First, the relative cost of storing raw apples, bulk juice, concentrate, and retail packaged juice is a crucial element in the analysis. Second, the cost implications of operating juicing and concentrating facilities only during harvest rather than throughout the year must be clearly understood. Indeed, for canners one of the greatest attractions of imported concentrate is the fact that the raw material for their canning operations is available throughout the year reducing their unit

overhead costs. Finally, carrying charges vary significantly between the strategies because the value of inventory to be carried varies considerably. The first strategy (juicing apples from storage) has the advantage of allowing juicing and packaging activity throughout the year. It has the disadvantage of producing juice of varying quality through the year. As the storage season progresses the juice produced will have a lower acid and higher sugar content. One method of maintaining consistent quality would be to blend in high acid concentrate later in the season. This approach is unattractive at the moment because such a product would have to be labeled "reconstituted" and would probably be subject to a price discount.

The second strategy (bulk storage of juice) has the advantage of allowing packaging activity throughout the year and allowing the production of a consistent product. Although carrying costs would be higher than for storage of concentrate, they would probably be lower than the carrying costs for retail packaged product because of the lower value of inventory to be financed. In addition, an opportunity would exist to extend the juicing season. Juicing could start earlier than it does presently because the high acidity juice produced early in the season could subsequently be mixed with lower acidity juice produced later in the season. This tactic could even be used to improve the quality of juice made from stored apples. The major advantage of this approach would be the opportunity to package a product of consistent quality throughout the year while avoiding the price discount associated with reconstituted juice.

The third strategy (concentrate production) has the advantage of low storage costs, moderate carrying charges and the utilization of packaging facilities throughout the year. The disadvantage is that the product marketed is reconstituted and would sell at a discount.

The fourth strategy (juice storage in retail packages) has the advantage of producing a product that commands a price premium, a product of consistent quality throughout the year (but not necessarily from year to year), and moderate storage costs. The disadvantages are higher carrying charges and the confinement of processing and packaging activity to the harvest season. This strategy, which is the one most prevalent in Eastern Canada at the present time, has the additional disadvantage of concentrating packaging activity in the harvest period. Packaging facilities then have a substantial incentive to package reconstituted product (from imported concentrates) through the remainder of the year.

Some additional considerations that are relevant to determining the "best" strategy for the Canadian industry are the overall trade status for apples and apple products, and consumer attitudes to fresh and reconstituted

products. Since Canada is a net importer of apples and apple products and is likely to remain so for the foreseeable future it seems inappropriate to try to compete on the international juice market. Concentrating facilities in Canada would be expected to operate only during harvest to produce a product that would compete with imported product. This would in turn remove "pure" product (which is preferred by consumers and commands a price premium) from the Canadian market.

The two crucial elements of an appropriate strategy are that the emphasis on pure juice be maintained since the market apparently still prefers the pure product, and that some effort be made to provide packers with a supply of pure juice for packaging throughout the year in order to reduce the attractiveness of reconstituting. The strategies that best meet these requirements appear to be bulk storage of single-strength juice, and storage of apples for juicing throughout the storage season.

The main difficulty to be overcome if the storage of raw apples strategy is adopted is ensuring that the juice packer will be able to produce a juice of consistent quality. This would involve additional planning with regard to the varieties grown and stored for juicing purposes.

Another option would be to facilitate the marketing of blended pure and reconstituted product. This approach would allow packers to maintain consistent quality but consumer attitutes to blended products are crucial in this approach, and are not at present known.

The option that appears to meet both criteria at a reasonable carrying charge and without the product being subject to a price discount is the bulk storage of juice. Unfortunately, experience with this new concept came to light as this report was being completed and a detailed evaluation of costs and other advantages or disadvantages of bulk storage was not possible. Bulk storage of single strength juice would allow packers to package a "pure" product of consistent quality throughout the year.

INTERVIEWS CONDUCTED

1) Allen Borthwick, Tri-County Apples, Trenton

2) Peter Cox, Fuerst Day Lawson Citrus Limited, London, England

3) Gilbert Sindelar, Foreign Agriculture Service, United States Department of Agriculture.

4) Jack Gerein, Sun-Rype Products Limited, Kelowna, B.C.

5) Barry Paul, Alfa Laval Limited, Peterborough, Ontario

6) Cullis Groom, APV Crepaco, Weston, Ontario

7) Richard Contino, APV Crepaco, Weston, Ontario

8) Food Processing Equipment, Kalamazoo, Michigan

9) Peter Butland, Butland Industries, Caledon, Ontario

10) Russel Rumble, Empress Foods, Leamington, Ontario

11) Ted Chudleigh, Ontario Food Processors Association, Toronto, Ontario

12) Doug Gendron, Campbell's Soups, Toronto, Ontario

13) Duffy Smith, Campbell's Soups, Toronto, Ontario

14) Gerry Long, Ontario Apple Commission, London, Ontario

15) Richard Bullock, B.C. Fruit Growers Association, Kelowna, B.C.

16) Dr. R. Miller, Smithfield Experimental Farm, Trenton, Ontario

17) Deloitte Haskins + Sells International Co-ordinators in South Africa, Argentina, Chile, and West Germany.

18) Canadian Embassy Commercial Counsellors in Hungary, Austria, South Africa ,Argentina, Chile, and West Germany

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